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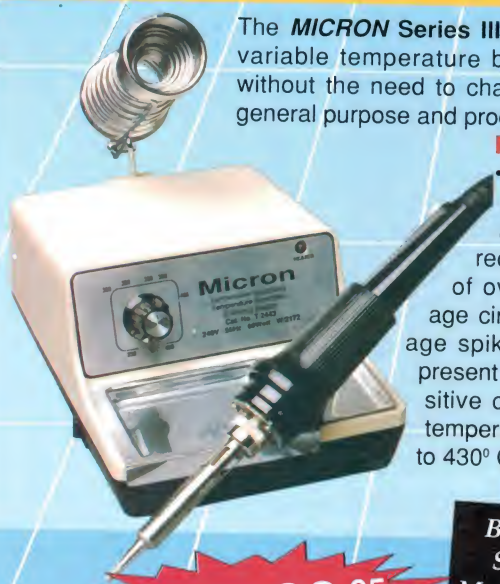

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Electronics AUSTRALIA WITH ETI

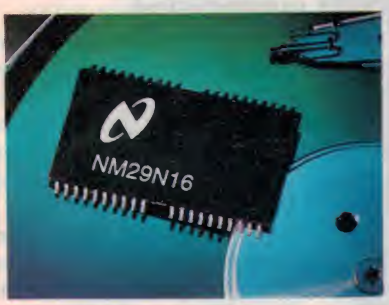
Volume 57, No.5
May 1995

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Another US software guru...

There are plenty of US software gurus who aren't billionaires, as Tom Moffat found on his recent trip. In his Madhouse column this month Tom tells the story of Eric Meyer, whose shareware word processor VDE is used around the world — but he still hasn't given up his day job... (See page 30.)

'Hard disk on a chip'



National Semiconductor's new NM29N16 flash memory device packs 16Mb (two megabytes) of data into a high-density chip running from a single 5V supply. It's been dubbed the 'hard disk on a chip'... (See page 110.)

On the cover

Our main photo this month shows FPC artist Aristea Kartsonas with some of VAF's new range of kit speakers for audiophiles (see our review starting on page 8). The smaller photo shows our new economy Surround Sound Decoder project (see page 68). Photos by Greg McBean.

Video and Audio

Features

Projects and Technical

Professional Electronics

Columns and Comments

Departments

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LETTERS TO THE EDITOR

Already available

In the Information Centre of your December 1994 issue, Mr Grygorowicz of Rowville, Victoria enquired about an engine temperature alarm and Peter Phillips made several suggestions — but why re-invent the wheel?

Past National President of the Inventors Association of Australia, Charles Smith, OHM, invented just such an alarm and it has been marketed by Utilux as catalogue number H41000/E2, 'Thermalarm'.

'Thermalarm' senses the temperature of the metal in the engine and sounds an alarm whenever the metal temperature exceeds the safe running level.

Buzz Cousins,
Past Federal President, IAA,
Balwyn, Victoria.

'Mu Follower'

The Mu Follower topology used in the valve preamplifier in your issue of October 1994, (pages 60 - 63) particularly interests me. I have used an identical arrangement, (except for valve types) operated at a B+ of 600 volts, to obtain the large grid drive required for the output stages of two 90-watt valve power amplifiers operating in split load configuration. The designs for these amplifiers were realised in recent years to make good use of a long term accumulation of transfers, valves, etc., — it was either use it all, or junk it!

My 'Mu Follower' circuit orginates from C.T. Murray ('Low Distortion Single Ended Push-Pull Audio Amplifier' — *Proc. I.R.E. (Aust.)* March 1960). I use ECC83 (12AX7) valves, driven directly by cathode followers to minimise the large input capacitance and to eliminate coupling capacitors. Both this and the high gain allow for considerable stable feedback from the 'Mu Follower' outputs back to the grids of their drivers.

Output valve groups, in parallel push-pull, are 4xEL34 and 6x6L6, with positive grid drive from direct coupled 6SN7 cathode followers, which in turn are driven by the 'Mu Followers' (on which input capacitance loading is thus minimal).

Output valve screens are maintained at cathode potentials (for correct pentode or tetrode operation), by centre tapped chokes supplying their B+ and by large capacitors connected to the relevant cathodes. To extend the 'linear' signal range, bootstrapping is applied, in one amplifier, to the 6SN7 drivers of the 6L6's (which afford a correct convenient B+ source) and in both amplifiers, partly to the 'Mu Followers'.

Such a low gain, low distortion output stage reduces the needful amount of overall feedback, taken from the output transformer secondary to an earlier voltage stage.

The various direct interstage couplings also improve the low frequency stability margins for this feedback. With separate power supply units for the amplifiers, each pair groups nicely on the base of a speaker stand giving compactness and short speaker leads (25cm), as well as considerable inertial stability for the stand.

Power delay relay circuits afford thorough preheating of all the valves — strongly recommended for long valve life.

R.B. Nevin,
Christchurch, NZ.

DMM appreciated...

I would like to thank Electronics Australia for the HP 973A multimeter (EA subscription competition). I was surprised to hear about the prize, as I had no idea there was a competition running! I am of course delighted and very grateful.

The multimeter is a vast improvement on the one I had been using which had very limited features (it cost about $30) and as I am embarking on several years of medical research, which will almost certainly involve some electronic work, I'm sure it will prove to be extremely useful.

Thank you very much once again.

Dr John Loadsman,
Camperdown, NSW.

...and another

I would like to thank Electronics Australia and Hewlett Packard for the great digital multimeter that I have won, in a recent subscription promotion. The meter will be of great value as it is capable of performing true RMS measurements and able to measure dBm levels for use with adio line level adjustments in PA equipment, etc.

It was a pleasant surprise to receive the letter from Federal Publishing Company notifying me of this win.

Peter Kutas,
Shortland, NSW.

Protection circuitry?

In the December 1994 issue of EA, the 'Discovery' series: Flash Dash article notes that 6V or less is vital for the circuit's continued functional existence. We wonder why the designers didn't put in a simple 5V regulator and then run the circuit off 9V? The same paragraph of cautions includes a reverse polarity warning for the battery's hook-up. What's wrong with a protection diode? It's not exactly an expensive component. The 'discovery method' of learning the usefulness of these little circuit extras can be expensive and frustrating.

We've done some 'discovery learning' on retail electronics gear designed to be run off DC.The first experience was with a TEAC 'ghetto blaster' without reverse protection circuitry. Its power ICs didn't appreciate a -12V supply. The repair and addition of a protection diode cost $75.

We recently did some more 'discovery learning' with a very neatly designed Panasonic answering service which runs off a 12V plug pack. Not all plug pack jacks are wired with positive and negative the same way around, so it's easy to mix up plug packs for various gadgets which use such a plug pack, and thus reverse the supply polarity. A brief bout of -12V on the answering service resulted in a dead one, with most of the logic chips gone. An even more expensive error: $130 for a new one, this time.

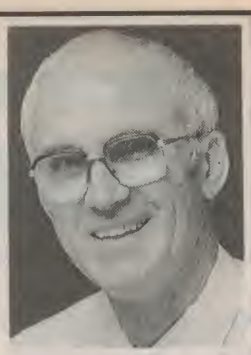
Mistakes like ours should not result in major appliance failure. We expect, for example, to have protection against engine failure in our cars from inadvertent use of leaded fuel in an unleaded engine. It is made physically difficult to make the error. Surely the electronics industry should be able to provide inexpensive circuitry to protect their gear from similarly inadvertent mistakes made by their customers.

Returning to the 'Discovery' series: as educational circuits, surely the teaching of good design includes, rather than ignores, protection circuitry for the end user.

Linda White and Gavin Wright,
Durham Lead, Vic.

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



Amateur licence fees: the battle continues...

In the March issue, you may recall, I commented here on the proposal by the Spectrum Management Authority to increase radio amateur licence fees, as part of its overhaul of licensing for all spectrum users. Despite my attempts to be as objective and as fair as possible, I managed to upset quite a few amateurs in the process.

Mind you, I did make a couple of unfortunate errors of fact, as quite a few people were quick to point out (some of them not very nicely!). One was to claim that amateur licence fees hadn't risen for about 10 years; this is certainly wrong, as they've risen from $23 pa in 1986 to $37 pa in 1995. My apologies for this inadvertent mistake — I should have checked, rather than relying on memory.

My other error, it seems, was to suggest that there had been 'prolonged negotiations' between the SMA and representatives of the WIA, which had resulted in the whittling down of the proposed new fees from an original 'formula' figure of around $500 down to a figure of around $70. I've since discovered that to describe the negotiations as 'prolonged' was wrong; in fact they seem to have been relatively short, and unfortunately delayed. In retrospect, 'last minute negotiations' would have been a more appropriate description.

Although all kinds of theories seem to have been circulating in amateur radio circles regarding the reasons for these negotiations having been delayed and curtailed, I believe it's not in the best interests of amateur radio to explore this further here. Suffice it to say that from what I've been able to learn, the WIA itself must shoulder a good deal of the responsibility for what happened.

In any case, events have moved on. Once it became clear that the proposed fees could be as high as $71, a ground swell of protest built up among amateurs as a whole, who sent large numbers of letters to their MP's as well as petitions to the Minister. As I write, this plus pressure from the WIA seems to have resulted in the Government deciding to reduce all of the new amateur licence fees to a flat rate of $51, corresponding to around half of the SMA's proposed rises.

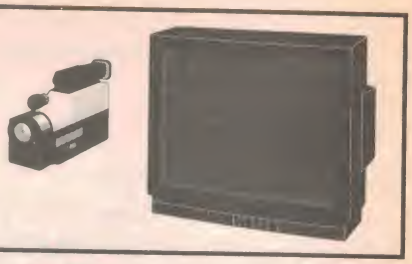
Not surprisingly, many amateurs are still not satisfied. Now that the whole issue of fees has been raised again, they're determined to apply renewed pressure for abolition of amateur licence fees altogether. And that's their right, of course.

As I said here in March, I do believe that you could build a good case for abolishing amateur licence fees. Regardless of how much total spectrum space is currently allocated to amateurs, and quite apart from the valuable roles played by amateurs in times of natural disaster, one can indeed argue that the amateur bands are in the nature of internationally sanctioned 'spectrum parks', which allow innovators of all ages to gain important practical experience in radio, data and satellite communications, and data processing technology — at little or no real cost to the public. Encouraging innovation of this kind is surely something that Australia must do, if we are to maintain our status as the 'clever country'...

The NSW Division of the WIA has been active in promoting this view, as have others in the amateur radio movement. I wish them every success.

Jim Rowe

What's New in VIDEO and AUDIO



New hi-fi speaker range from DALI

Danish hi-fi loudspeaker system maker DALI has released a new range known as the Blue Line series. The new range complements the firm's existing Red Line models, and offers high quality reproduction at competitive prices. All systems are based on bass reflex enclosures, with dome tweeters employing a coated cloth dome and ferrofluid damping and cooling.

There are five models in the new range. Smallest is the model 102, a compact two-way bookshelf system with a single 6.5" woofer in each 315 x 255 x 210mm box, and rated at 60W continuous (100W peak).

Then comes the model 103, also a two-way bookshelf system but with a single 8" woofer in each 450 x 260 x 250mm box and rated at 70W continuous (100W peak).

The model 104 is the smallest floor-standing system, and is again a two-way type with two 6.5" woofers in each 870 x 270 x 216mm box. This system is rated at 120W continuous and 150W peak, with a sensitivity of 93dB (2.83V/1m), a nominal impedance of 4Ω and a rated response of from 43Hz to 25kHz +/-3dB.

Larger again is the model 107, a three-way system with a 12" woofer and 4" midrange driver in each 960 x 300 x 280mm box. The woofer employs a special four-layer voice coil with high 'utilisation ratio', and a double centre cap to minimise resonances. This system is rated at 100W continuous/150W peak, has a sensitivity of 92dB (2.83V/1m), a nominal impedance of 4Ω and a rated response of from 43Hz to 18kHz +/-3dB.

Top of the range is the model 109, again a three-way system but with two 10" woofers and a 5" midrange driver in each 1050 x 380 x 300mm box. Each woofer operates in its own bass-reflex enclosure in this system, giving exceptional bass performance and power handling capability. The 109 is rated at from 20 to 500W, with a sensitivity of 93dB (2.83V/1m), a nominal impedance of 4Ω and a rated response of from 42Hz to 18kHz +/-3dB.

Retail prices of the new DALI systems range from $698/pair for the model 102 to $2298/pair for the 109, with the model 104 system positioned at $1098/pair.

Further information is available from Scan Audio, 52 Crown Street, Richmond 3121; phone (03) 429 2199 or fax (03) 429 9309.

Philips and Sony propose multisession music CD

Philips Electronics N.V. and Sony Corporation have announced that tenta-

Personal TV projector available

Recently released in the USA, the Virtual Vision 'Sport 100' personal Projection TV system is now also available in Australia.

Virtual Vision Sport is described as a portable TV receiver with what is effectively a 'big screen' virtual colour image, built into a high-tech headset. A special optical system within the 'glasses' part of the headset reflects full-colour images into the user's eyes — creating a 'floating' picture which appears to be quite large, and some metres in front. At the same time, the user can see their normal environment so they don't become disorientated. The headset also provides built-in high fidelity earphones, yet only weighs a total of 140 grams.

The VHF/UHF TV receiver section of the Sport 100 is built into a small belt pack, along with the antenna, controls and rechargeable batteries. A small cable links the belt pack with the headset, allowing the user a high degree of mobility.

The Virtual Vision Sport will also accept video from a VCR, camcorder or laser disc player, allowing it to be used as a personal multimedia viewer. Shortly it may also be compatible with computers and video games, as a 'virtual reality' display.

The Australian RRP of the Virtual Vision Sport 100 is $1199. For further details circle ... on the reader service card or contact the sole distributor for Australia and New Zealand, Selandia Pty Ltd of 10 Webbs Lane, Somerville 3912; phone (059) 776 035, or fax (059) 778 468.

tive basic specifications for the new multisession music CD (also referred to as 'CD Plus') are available for evaluation and consideration by record and computer companies. Said proposed specifications will define a multisession type of prerecorded (stamped) CD disc.

The proposed new basic specifications for multisession CD would open the possibility to combine existing CD standards on one disc. A multisession music CD combines normal audio tracks with additional CD-ROM information. The audio tracks will be recorded in the first session, whereas the additional information will be recorded in the second session.

The development of the first step of the proposed multisession music CD format now has been completed. In order to finalise the multisession music CD format Philips and Sony will continue to consult with record and computer companies in order to attempt to achieve compatibility with major multimedia personal computer platforms, such as Multimedia PC's and Macintosh computers.

Midi system with Dolby Pro-Logic

Kenwood's latest M-969M and M-868M midi systems are claimed to make home theatre a reality, as they offer both Dolby Pro-Logic Surround Sound and Dolby 3 stereo. When configured with a video system such as a VCR or laser disc and connected to a TV set, videos come to life with the crisp dialogue and dramatic surround sound as intended by the film maker.

The vanguard M-969M model boasts Kenwood's novel 'omni-directional' speakers, which radiate sound to every corner of the room. Each speaker is two speakers in one — a full range three way speaker system and an omni-directional speaker that radiates the sound through the use of a 90° reflector.

Both models offer four channel amplification, with 80 watts/channel for the main speakers, 12 watts for surround speakers and 10 watts for the centre speaker. In addition, both systems are configured with a subwoofer output for extended bass response.

A 'depth control' feature brings the vocalist forward or backward, creating realistic soundstage depth. Both models also feature a 13-band equaliser/spectrum analyser, 30 pre-set AM/FM stereo tuner, double cassette deck Dolby HX-Pro/Dolby B/C and seven CD filing system CD player.

Both models are covered by a two year warranty (12 months on CD laser pick-up) and have an RRP of $3299 (M-969M) and $2499 (M-868M). For further information on Kenwood's new midi range ring (02) 746 1888. ❖

Super Drive VCR with G-Code

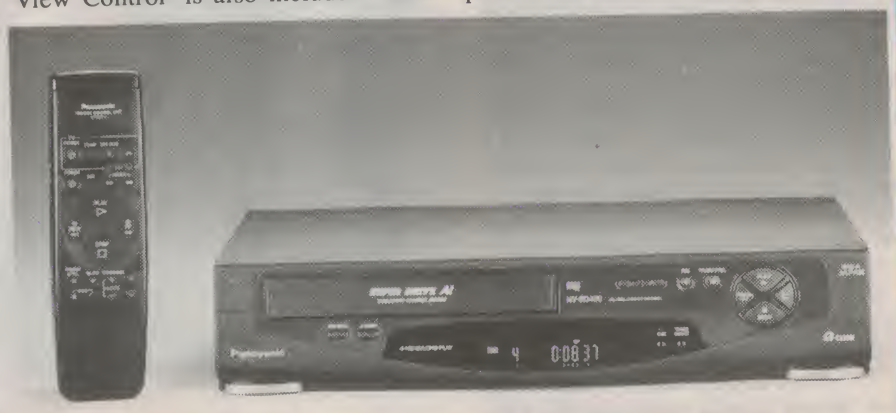
Panasonic has recently released a new VCR which is part of its Super Drive Video Cassette Recorder range. The NV-SD400A is a four head mono machine with long play record and playback and like all Panasonic VCRs it has a one piece aluminium die-cast chassis.

It includes G-Code programming, which is growing in popularity with consumers. G-Code programming allows the user to enter a code into the VCR via the remote control which instructs the VCR to record a particular program. The G-Code numbers are now published in a number of leading television guides.

The NV-SD400A is the first Panasonic VCR to feature AI (Artifical Intelligence) On-Screen display. The On-Screen display guides the user through the operations with step-by-step instructions on the TV screen. It includes tuning, G-Code programming, 'Four key' programming, clock setting and a demonstration mode. It also displays warning messages if a mistake is made — for example, 'Please use a cassette with tab' if you are trying to record a program.

AI (Artificial Intelligence) 'Crystal View Control' is also included. This new technology automatically checks the tape characteristics and compensates the heads to provide optimum picture quality even on repeatedly used video tapes.

The Panasonic NV-SD400A is available from leading electrical retailers for a recommended retail price of $729.



VAF UPGRADES ITS SPEAKER KITS

South Australian firm VAF Research has just revamped its very popular DC range of hi-fi kit loudspeaker systems, with the release of its new 'Series II' models. Here's what we found when we tried out some of the new models...

by JIM ROWE and ROB EVANS

Regular readers of *EA* may recall that in the November 1992, we published an article by Philip Vafiadis, chief designer and managing director of VAF Research, explaining the philosophy behind the development of his then-new DC series of high quality speaker kits. The article gave valuable insights into modern speaker system design, and helped to explain why the DC series of kits went on to become extremely popular.

At the time, VAF Research very kindly sent us samples of the DC series models, which we were able to test using our Audio Teknology 'LMS' PC-based testing system, and also evaluate subjectively by listening to them in typical home listening room environments. And we were very impressed; the overall performance of each model was very smooth and clean, and gave evidence of careful choice of drivers, thorough design and high quality manufacture. Inevitably both bass response and power handling capability improved with the larger models, but even the smallest system gave a very good account of itself.

On the whole, then, the original DC Series models seemed to offer impressive performance. As VAF was also offering the kits at quite reasonable prices, this made them especially attractive; and accordingly we were not surprised to hear that they'd become very popular.

But clearly Philip Vafiadis hasn't been resting on his laurels, because he has just released a new 'Mark II' range of DC Series kits, to replace the original models. Louis Challis reviewed one of the new systems — the DC-7 MkII — in our April issue and was quite favourably impressed.

This month we're having a quick look at three of the new models, and comparing them with the earlier DC Series systems. The MkII models concerned are the DC-5, a compact sealed system with three drivers in each enclosure; the DC-7, a larger floor-standing vented system with three drivers per enclosure; and the even larger DC-9, with five drivers per enclosure. We looked at the 'MkI' versions of the DC-5 and DC-7 in 1992, but the DC-9 is an addition to the range.

Overall improvements

According to the VAF literature, the new MkII series has been designed to provide improved performance in many different areas. These include flatter frequency response, lower total harmonic distortion (THD) and intermodulation distortion (IMD), better resolution of sonic detail, greater dynamic linearity at all levels and frequencies, improved transient response and transient decay, higher power handling and improved resistance to heat and humidity.

One major contributor to this improved performance is the use of a new and specially designed 130mm woofer, offering a larger linear excursion capability and optimised magnetic field out of the gap. The new woofer also incorporates a rubber roll surround of improved stability, a mica impregnated polypropylene cone and optimised cone geometry, mounted in a rigid and non-resonant die-cast frame. In addition, the four-layer high temperature voice coil is wound on an aluminium former, with a secondary spider support described as 'enclosing a precise volume of air'.

A second major feature of the new models is a new 25mm metal dome tweeter, again specially designed, with a precision ground dome mounted in a

The DC-5 enclosures are visible in the centre of this shot, with the DC-7 enclosures next and the DC-9 enclosures on the outside. All have very nicely finished cabinets, but are also very easy to assemble.

very compliant rubbery roll surround. A double chamber construction is used for improved damping, and the tweeter also incorporates an accurately positioned diffuser plate for wide and even dispersion.

Other factors which VAF credits for contributing to the improved performance of the MkII models are improved first-order crossover design with impedance and frequency response compensation, the use of high voltage 5% tolerance capacitors and air cored 1% tolerance resin-bound inductors; and higher quality internal hard wiring.

By the way, all kits in the new series have pre-assembled crossover modules and are available either with, or without VAF's own fully built and finished cabinets. If you purchase a kit with the cabinets, all that you have to perform yourself is the final assembly process.

Whereas the original DC-Series kit cabinets had a distinctive 'grey pebble finish', which people tended to either love or hate, all of the new MkII models use a very high quality two-pack black lacquer finish. The exception is the smallest DC-1 system, whose boxes are of die-cast aluminium and finished in black powder-coat enamel. Apart from this model, the cabinets are made from high density MDF board, with full mitreing for virtually invisible joints. In all cases the front grilles use acoustic cloth and are attached using sturdy plastic 'ball and socket' fasteners.

Another feature of the new series is heavy-duty gold plated input terminals, on all but the DC-1 model.

Overall, VAF says that as well as offering an excellent standard of finish the new models also offer very consistent acoustic signatures, and essentially 'true audiophile' performance at low prices rather than merely good value for money...

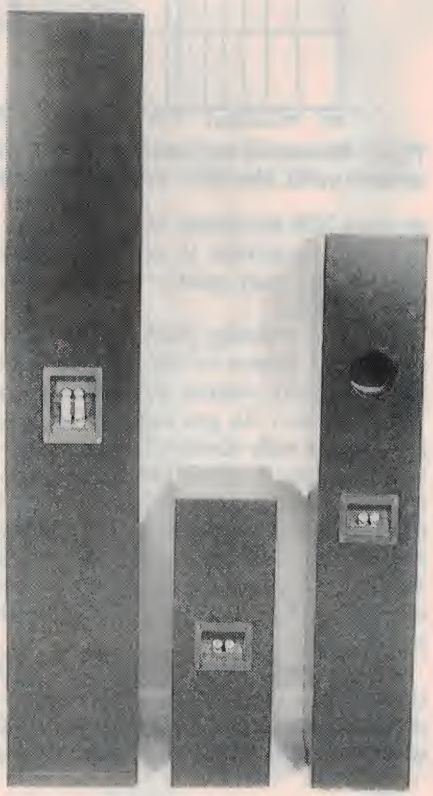
The DC-5 MkII

The DC-5 MkII is the smallest of the three new models we were sent for this review, with each enclosure measuring 480 x 295 x 160mm (H x D x W). Like its predecessor, this system is intended for either bookshelf use, or with the cabinets mounted on small floor stands.

Two of the 130mm woofers are used in each box, with the dome tweeter in the centre between them. The boxes are of the sealed or 'infinite baffle' type, which VAF describes as 'hypersoft sealed' — presumably because of the use of 'hypersoft' acoustic foam damping material inside. The tweeter is mounted flush in the front surface of each box, without any felt surround.

Rated frequency response of the DC-5 is from 65Hz to 22kHz +/-2dB, as measured at 2m on axis using 1/3 octave filtering. The rated power handling capacity is 30-100W RMS per channel, with a sensitivity of 89.5dB at 1W and 1m. The enclosures have a nominal 6Ω impedance with a minimum of 4Ω.

The quoted price for the DC-5 MkII kits is $449/pair without cabinets (plus $19 for freight and insurance), or $605/pair with cabinets (plus $23 for F&I). It's also available fully assembled for $725/pair, again plus $23 for F&I.



The rear of each system cabinet. As you can see the DC-7 on the right has a rear port, while the DC-9 on the left has dual terminals for bi-amp wiring.

The DC-7 MkII

Larger than the DC-5 is the DC-7 MkII, which is the smaller of VAF's two floor-standing models. Here the cabinets measure 900 x 295 x 160mm (H x D x W). Like the earlier DC-7 the new version has the drivers mounted in the upper part of the cabinet, although the dress grille now covers the entire front for a cleaner 'line'.

As with the DC-5 the DC-7 uses three drivers per box, with two of the 130mm woofers in vertical alignment and a tweeter centrally between them. However as with the earlier DC-7 system the new one is a bass reflex design, with a rear port. VAF describes it as a 'hypersoft bass reflex', because of the internal filling material used for acoustic damping. The tweeter is again mounted flush in the front panel, but in this case it is surrounded by a sculpted square of acoustic felt, with a 'multi petal' central cutout to control edge reflection and peripheral radiation.

The rated frequency response of the DC-7 MkII system is from 38Hz to 22kHz +/-2dB, on axis at 2m using 1/3 octave filtering. The rated power handling capability is 30 - 100W RMS per channel, with a sensitivity of again 89.5dB/1W/1m. The nominal impedance is again 6Ω, and the minimum impedance 4Ω.

The quoted price for a DC-7 kit is $585/pair plus $19 F&I without cabinets, $749/pair plus $29 F&I with cabinets, or $945/pair plus $29 F&I fully assembled and tested. An optional floor spike kit is available for $20/pair extra. Other optional extras include magnetic shielding ($50/pair), bi-amp wiring ($50/pair), upgraded internal wiring ($35/pair) and 'Ultra' grade crossovers ($85/pair).

The DC-9 MkII

Largest in the new DC-Series kit range is the DC-9 MkII, which has floor-standing cabinets measuring 1230 x 320 x 210mm (H x D x W), with a sturdy plinth at the base. A compartment at the base of each box can be filled with sand or lead shot if desired, for added stability.

Each DC-9 box has five drivers, mounted in the upper 60% of the front panel. At the top are two of the 130mm woofers, then the tweeter and finally another pair of woofers. There's a little more space between the woofers and the tweeter, compared with the smaller models, and the tweeter is further recessed — presumably to give a closer time alignment with the woofers. This model also provides the tweeter with a double layer, stepped and sculpted felt surround for improved control of edge effects.

The rated frequency response of the DC-9 MkII system is from 38Hz to 22kHz +/-2dB, at 2m on axis and using 1/3 octave filtering. It has a rated power handling capability of 40 - 150W RMS per channel, with a sensitivity of 90dB/1W/1m. The nominal impedance is 8Ω, with a minimum of 4Ω.

The quoted price for the DC-9 MkII kits is $799/pair plus $29 F&I without cabinets, $995/pair plus $48 F&I with cabinets, and $1299/pair plus $48 F&I fully assembled and tested. As before there's an optional spike kit ($20), magnetic shielding option ($90/pair),

upgraded internal wiring option ($50/pair) and 'Ultra' crossover option ($160/pair). The DC-9 comes with bi-amp wiring as standard.

What we found

First off, we were very impressed with the level of finish in the sample DC-Series MkII systems. The original units were very good in this respect, but the new models are even better. They're quite the equal of most commercial systems, and would look good in just about any listening room.

To get a better idea of the level of performance enhancement that VAF has achieved with the new range, we ran all of the systems through our IMP PC-based testing system. Since we also had access to the original DC-5 and DC-7 models, we also tested these again with the same system to ensure that we were making a fair comparison. (By the way, for a more comprehensive set of test results on the DC-7 MkII system, refer to last month's review by Louis Challis.)

The frequency response curves we achieved for the DC-5 systems are shown in Fig.1. Here the plot for the new MkII version is identified with 'filled circles', while that for the original version has small triangles. The plots were taken at 1m on the tweeter axis, and with 1/3-octave filtering.

As you can see, the new DC-5 is noticeably flatter than the original, and has a significantly better high-end response as well as lacking the original's broad and noticeable dip at around 1.6kHz. There's now a much smaller dip of about 3dB just above 3kHz, but otherwise the response is commendably smooth and very gently rising all the way to 20kHz.

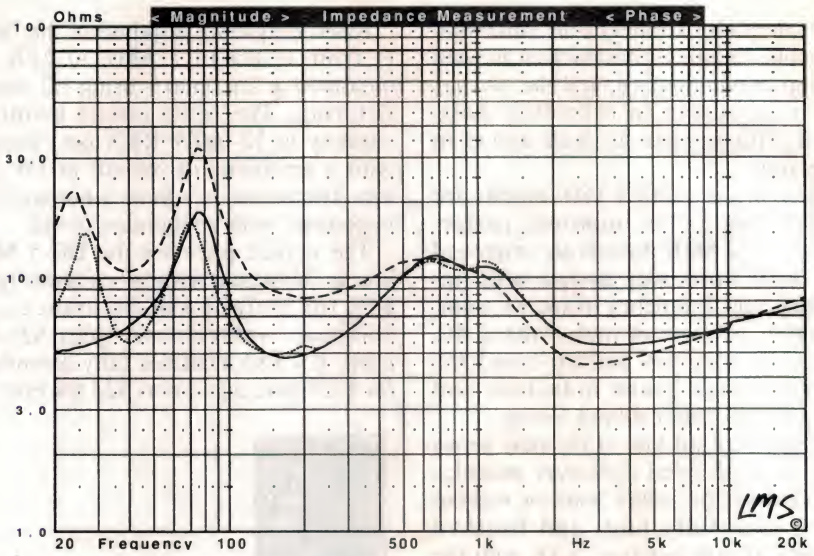


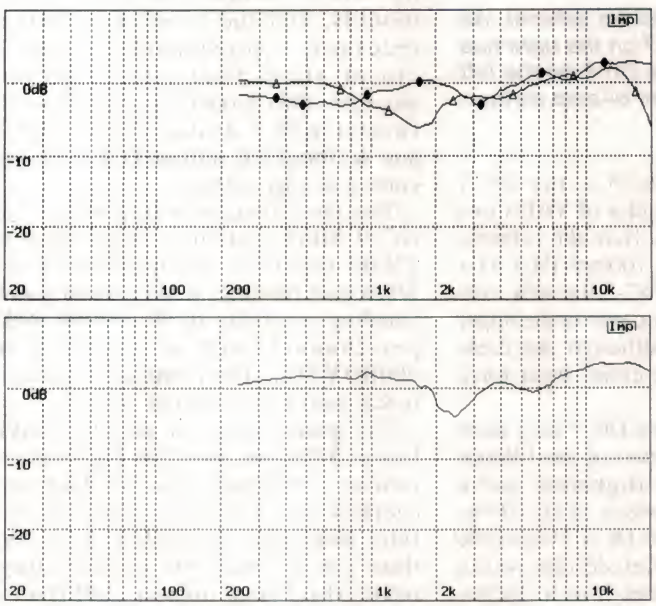
Fig.4: Measured impedance plots for the three new VAF systems, with the DC-5 shown solid, the DC-7 as small dots and the DC-9 as dashes.

The corresponding plots for the DC-7 system are shown in Fig.2, again with the new MkII version identified using 'filled circles'. As you can see the new DC-7 is not only about 4-5dB more sensitive than the original, but is again flatter and with a noticeably extended high-end response. As Louis Challis found, there's again a dip at around 3kHz, in this case of around 6dB, but otherwise the response is again quite smooth up to 20kHz.

Our response plot for the DC-9 MkII is shown in Fig.3. Again it's commendably smooth, apart from a modest dip of around 4dB at 2.4kHz, with again a gentle rise to about 14kHz and then a very gentle roll off.

Note that all three of these frequency plots begin at about 250Hz, due to the difficulty in making reliable low-frequency measurements in our test room. However we did low frequency checks on all three systems, and here again largely confirmed VAF's claimed figures. The DC-5 sealed system gives a smoothly maintained response down to around 60 - 65Hz, while the two larger bass reflex enclosures provide clean and equally smooth output down to around 40Hz.

Fig.4 shows the impedance plots of all three MkII systems, measured with LMS as this program does a better job in this area than IMP. The DC-5 plot is shown solid, with the DC-7 in small dots and



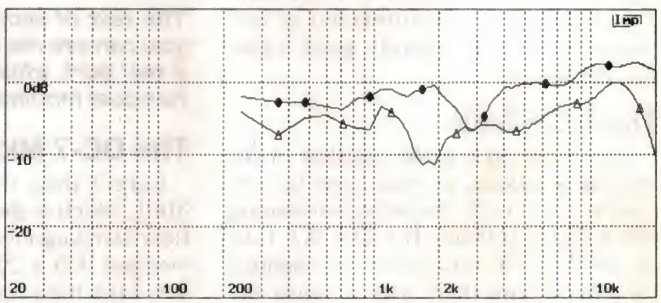


Fig.1 (top left): The measured frequency response for the DC-5 system, with the original model identified with small triangles and the new model with black circles.
Fig.2 (top right): The measured response plots for the DC-7 system, again with the original model identified with small triangles and the new model with black circles. Note the higher sensitivity of the new model.
Fig.3 (left): The measured response of the new DC-9 system. Apart from a modest dip at 2.5kHz, it's commendably smooth.

the DC-9 in dashes. As you can see they again confirm VAF's quoted figures for minimum impedance, with the DC-5 and DC-7 generally conforming to the 'nominal 6Ω' description and the DC-9 to its 'nominal 8Ω' figure. All three curves show evidence of fairly careful impedance compensation, and there's nothing that should embarrass any modern amplifier. But how do these new DC-Series speakers *sound*? After all, this is the real bottom line, where loudspeaker systems are concerned...

Well, we tried listening to all three of the new systems over an extended period, in a typical home listening environment and using a range of high quality, familiar tracks from CDs. The amplifier used was Rob Evans' Pro Series Mk1, by the way.

Our basic reaction in each case was that the systems were very smooth and 'clean', with excellent transient response and low audible distortion even at high listening levels. Needless to say the DC-9 system with its extra drivers and larger cabinets can handle more power than the other systems, but even the compact DC-5 system gave an impressive account of itself.

The treble response of all three systems was particularly smooth and free from 'hot spots', beaming or distortion of the stereo imaging, suggesting that VAF's new tweeter really is an exceptional performer.

The bass response was also very clean and free from 'lumpiness' — although the DC-7 with its rear port is naturally a little more sensitive to positioning, relative to the rear wall(s). And although the plots for both the DC-7 and DC-9 systems show that dip at around 3kHz, we really weren't aware of this in our listening tests.

Overall, then, we found all three of the sample MkII DC-Series systems particularly clean and well balanced. They're certainly much enhanced relative to the original versions, and as the originals were already very good, that says quite a lot.

Judging from the samples, VAF Research has certainly lifted kit loudspeaker performance to new levels with these models. They also compare very well indeed with commercial systems costing considerably more, which should make them of great interest to anyone seeking to achieve 'audiophile' performance on a restricted budget.

Further information on any of the kits in the DC-Series range is available from VAF Research at PO Box 380, Greenacres 5086; or phone (freecall) 008 818 882. ❖

VIVID 3D PLUS AMBIENCE ENHANCER

As a change from loudspeakers and other familiar items, this month we asked Louis Challis to test a rather more unconventional product: the NuReality Vivid 3D Plus, which is claimed to use innovative technology known as the 'Sound Retrieval System' to enhance the perceived acoustic performance of video games, multimedia computers and conventional stereo systems — without the use of any additional speakers or amplifier channels. Here's what he found...

The Nureality 'Vivid 3D Plus' is not like any of the products which have been sent to us for review over the last 25 years. It is certainly not the smallest, as that honour belongs to magnetic phono cartridges. (As an aside, the best of those cost considerably more than the Vivid 3D Plus.) By the same token, it's also not the cheapest product we have reviewed, although it comes close to winning that accolade.

Our reason for reviewing the Vivid 3D Plus is simply because it is one of the most unusual products that we've been offered. If that were not enough, it also has managed to create a market niche in an area where no one had dared to venture before...

The background of this product is an interesting story in its own right. Back in the early 1980's, an enterprising engineer with an avid interest in acoustics named Arnold Klayman started his investigations into psycho acoustics at the University of California. Not content with just sitting in classes and learning what others described, he decided to initiate his own research into an area which interested him. His investigations were directed to assessing how human ears localise sound binaurally.

What he discovered wasn't really new, nor was it earth shattering. However, his specific interest related to how he could electronically replicate the way the human ear (or what is known as the 'pinna' or fleshy external portion of the ears) modifies the spectral distribution of the sound energy that is finally sent through to the cochlea, and then to the brain.

What Klayman discovered was that each individual has to go through a learning process early in life, during which the brain learns to interpret the signals that it receives from the ears. The two pinnae provide the mechanism through which you are able to determine, with varying degrees of precision, the location of external noise sources which we all hear in our daily lives.

It took Arnold Klayman some time to develop a reasonable electronic analog of the way our external ears diffract and physically filter sound waves. He found that there are specific bands of frequencies whose relative levels are modified by our pinnae, and the modification process is what enables us to reinterpret, and thereby localise the original direction of those sound sources.

Of course as you are no doubt aware, no two sets of external ears are identical. Yours are different to mine, and consequently the pre-filtering and frequency selective process is unique for each individual. If somehow, or for some reason, a different set of ears were grafted onto my head, I would have to relearn how to interpret the incoming sound waves all over again.

At this point you may well ask how could Klayman replicate what *I* hear, or for that matter what you hear? Well, of course he couldn't achieve that aim, and that was not what he wanted to do.

His aim was to identify the common frequency selective trends in *all* of our ears, so that he would be able to replicate the trend, as opposed to the detail. Having developed an appropriate model, he would then be able to modify the electrical signal — which would then appear to have the spatial characteristics of sound similar to those that would occur had two microphones been used to record the sound to achieve a realistic stereo image.

Of course, it mattered not that the sound was not a 'true' stereo image sound. All that mattered was to create an illusion which was sufficiently close to the 'real-world' situation that the listener would be satisfied with its interpretation.

Klayman's research had showed him that

even a conventional TV set with closely spaced speakers, being fed with stereo signals, produced an audible signal which appeared to be essentially monophonic rather than being stereophonic.

Successful model

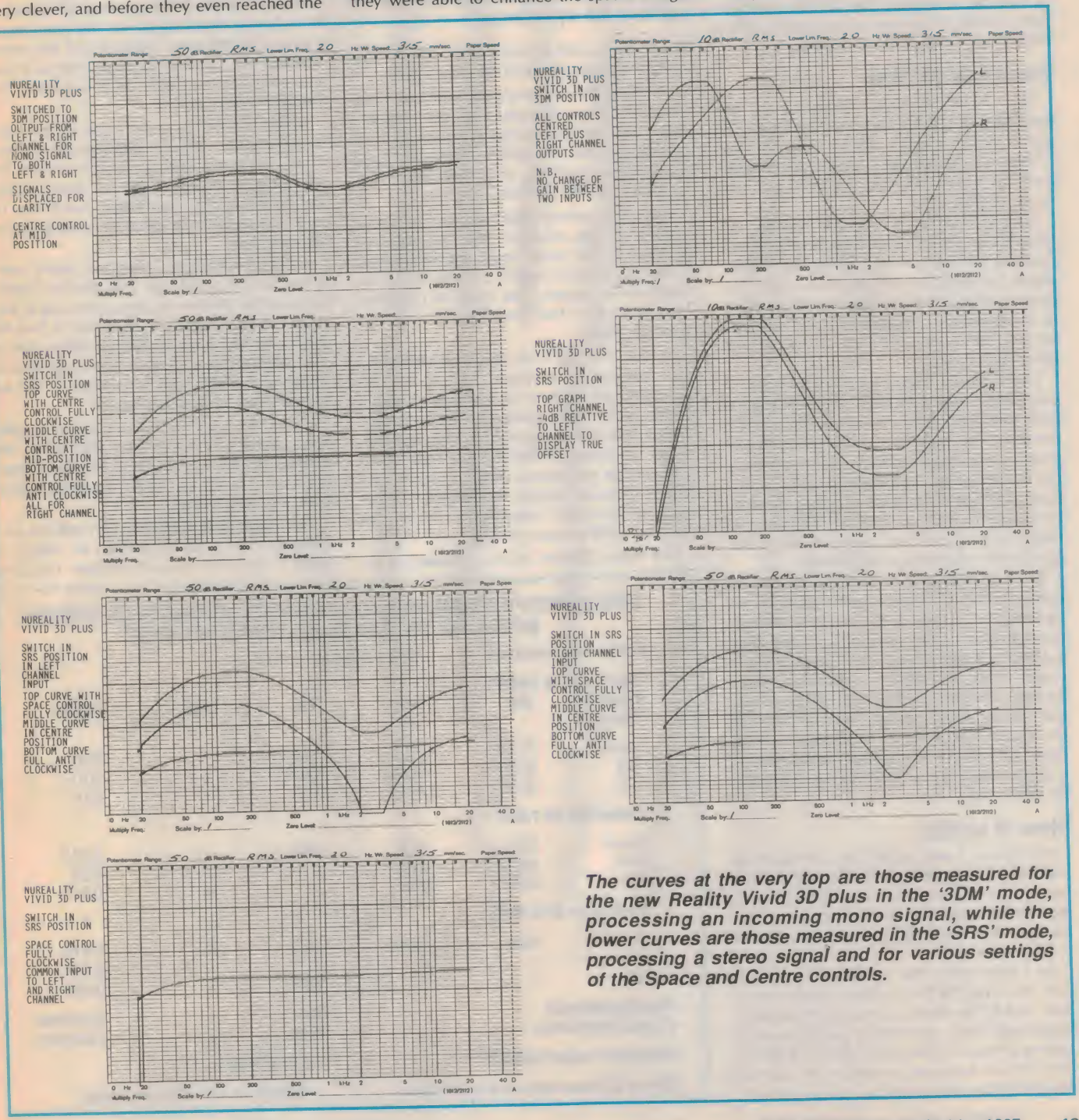
Klayman's model worked remarkably well, and most certainly well enough in early demonstrations for him to be able to sell his technology to the Hughes Aircraft Corporation. Hughes' interest came as a result of their expectations that they would be able to use this technology in automotive sound systems.

The corporate management at Hughes were very clever, and before they even reached the stage of putting the technology to work in cars, they demonstrated the attributes of their new system to a number of firms. Two of those firms, Sony Corporation and Thompson Consumer Electronics (which nowadays makes RCA TV's), were sufficiently impressed to negotiate non-exclusive manufacturing rights to what soon became known as the Sound Retrieval System or 'SRS'.

Both Sony and RCA soon integrated the SRS system as a basic addition to their top of the line TV sets. What they found was that even where the left and right channel's loudspeakers may only be a metre or less apart on the opposite sides of the TV cabinet, they were able to enhance the spatial image in a way that no other concept or product could match.

Even though the SRS system apparently achieved its primary claims, Hughes decided to sell its rights to the product. Apparently one of Hughes' senior staff members joined forces with another couple of enterprising marketing personnel to purchase the rights to the SRS system. Having found the capital to purchase the rights from Hughes, the company was saddled with 10,000 units which they were unable to sell into the marketplace.

The company lacked sufficient capital to get off the ground until 1993. At that point, the original trio were lucky enough to interest entrepreneur Thomas C.K. Yuen, who was co-



The curves at the very top are those measured for the new Reality Vivid 3D plus in the '3DM' mode, processing an incoming mono signal, while the lower curves are those measured in the 'SRS' mode, processing a stereo signal and for various settings of the Space and Centre controls.

founder and former co-chairman of AST Research (the computer company). Yuen was excited by what he saw and heard, and apparently decided to buy in, taking a major shareholding in the company.

With its new-found capital, the company was revitalised in late 1993. By early 1994 the NuReality company, as its manufacturing side became known, released its initial product line the Vivid 3D series of ambience-enhancement systems.

Now the original systems that Hughes Aircraft had developed were large units with fancy front display panels, and a selling price of US$399. The new Vivid 3D Plus systems were minuscule by comparison, with a selling price of only a third of the original.

The Vivid 3D Plus

The Vivid 3D Plus enclosure is extremely small, and weighs less than the 12V power pack supplied with it. The unit has relatively few controls on the small front panel; two switches supplemented by three rotary controls.

The ON/OFF switch at the extreme left controls the power. The second slider switch provides the two primary functional modes, which are described as '3DM' and 'SRS'. The centre position of this switch provides a 'BYP' or bypass mode. The '3DM' stands for '3D Mono', while the 'SRS' stands for 'Sound Retrieval System'.

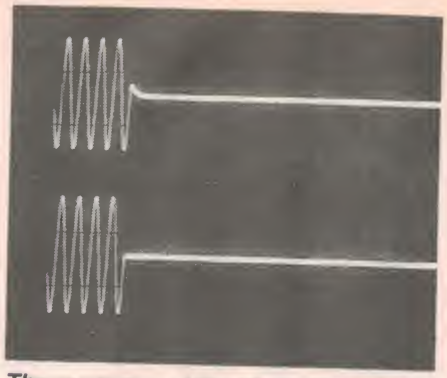
Three small rotary control knobs are provided on the right hand side of the small front panel. The first provides overall volume control. The second is labelled CENTER (American spelling), and sets the sensitivity of the 'centre stage' component of the signal being processed. The third and last control on the extreme right is labelled SPACE, and modifies the perceived width of the stereo signal when operating in SRS Mode.

The rear panel has an input socket for the external 12V AC supply plug, which is attached to a 2m lead at the end of a conventional 240V to 12V power pack. Three other sockets are provided. The first two are a colour coded pair of RCA coaxial signal input sockets, while the third is a miniature 'tip ring and sleeve' stereo socket. This provides the processed output signal from the Vivid 3D Plus, and comes with a matching lead which is terminated in a pair of RCA coaxial plugs at the other end.

How it works

Obviously, I was sufficiently intrigued to find out why it works. I was also interested to learn why so many other reviewers and magazines have commented on its performance either favourably, or some cases even in glowing terms.

As I discovered, the 'handbook' provided with the Vivid 3D Plus is small, and its text is brief and to the point. Essentially it provides appropriate basic instructions for the user on how to connect up the Vivid 3D Plus module. The primary emphasis is on how to use the Vivid 3D Plus with computer games and with hi-fi systems, and it provides no useful information on how the unit's circuitry works.



The response of the Vivid 3D Plus to a 1kHz tone burst, with the output at the top and the input below.

To learn how it functions took me some hours of patient measurements and investigations. That in turn resulted in numerous level recordings, many of which initially confused the mode of operation of the SRS technology incorporated into the Vivid 3D Plus.

I soon discovered that there are two basic circuits in this module. The first and as I perceive it, the more novel and interesting, is the 3DM circuit which is designed to enhance mono signals. The mode of operation here is to split the mono signal into two separate paths.

As you will see from the level recording, the frequency response of the 3DM generated left channel is markedly different to that of the 3DM generated right channel. With a true stereo signal, the differences between the signals in the left and right channels contain the critical auditory signal cues which provide spatial information in the form of spectral information, with appropriate differences in timing.

The data common to both channels is essentially the centre stage information. That monophonic information is basically equivalent to combining two stereo channels into one, and is equivalent to receiving the information in the same way that you would listen to a 1950 vintage monophonic microgroove recording.

The 3DM circuitry re-equalises the frequency response of the separate signals in each channel. This is achieved by super- imposing three broad band frequency peaks on the signal in the right channel, and in two different broad band peaks on the signal in the left channel. The re-equalised left and right channel signals display a completely different (revised) spectral balance when compared to the original mono signal. As the input signal varies, the frequency response and the output levels of the new left and right channels vary according to their pre- ordained frequency response contours.

When listening to the output, our ears automatically seek the appropriate auditory clues. What we find is that those clues are present more or less where we would expect to find them, and 'hey presto', our brains interpret what we hear as being a conventional stereo signal.

Of course the signal which we detect is not a true stereo signal, but that doesn't matter, because the illusion is created the way it was meant to be. The perceived reality is that the artificially generated frequency differences in the information convey a spatial depth and localisation ability which is similar to, but not the same as a true stereo signal.

The 3DM aspect of the circuitry is simple, and I believe relatively straightforward. By contrast the SRS circuitry is a trifle more complex and took a little longer to interpret both how, and why it works.

For a start the full SRS circuit starts has two controls, the most important of which is SPACE and the less important the one

MEASURED PERFORMANCE OF NUREALITY VIVID 3D PLUS SYSTEM
MODEL NO. VIVID 3D PLUS - SERIAL NO. 40989

1. **Frequency response** — 20Hz to 20kHz - 4 +1dB

2. **Distortion @ 100Hz**

Output Level	2nd	3rd	4th	5th	THD%
6V=0	81.0	87.3	100.9	-	0.01
-10	81.7	85.2	99.8	-	0.01
-20	81.5	84.7	-	-	0.01

3. **Distortion @ 1.6Hz**

6V=0	89.4	77.8	94.0	-	0.013
-10	85.4	81.2	-	-	0.01
-20	85.4	80.0	-	-	0.011

4. **Distortion @ 6.3kHz**

6V=0	82.0	79.0	83.3	-	0.015
-10	-	-	-	-	0.024
-20	-	-	64.1	-	0.062

Input impedance	Zin	=	47kohms
Output impedance	Zout	=	230ohms
Maximum output voltage	6.5 volts RMS		
Signal to noise ratio re 6 volt output	= 94.2dB(A0, 90.5dB(unweighted)		

labelled CENTER. When a common signal appears in both the left and right channels, the frequency response of the output circuitry is effectively flat and identical in both left and right channels.

But when a significant difference exists between the signal in the left or the right channel, and the SPACE control has been rotated clockwise to some point beyond the zero setting, the frequency response of the incoming signal is boosted at low frequencies, i.e., between 20Hz and 500Hz, whilst the signals between 1kHz and 5kHz are differentially attenuated. With increasing rotation of the SPACE control the level of low frequency boosting is increased, and the degree of unnaturalness of the sound is further accentuated.

With a modest degree of spatial contouring, the sound field is unquestionably enhanced, but like many things, too much of a good thing may achieve a counter-productive result. As the CENTER control is increased, a similar result is achieved with a gentle boost at the low frequency, a very shallow attenuation in the mid-frequency region, and a further modest boost at high frequencies. This is achieved in both channels, irrespective of whether there is a significant difference between the two signals of the channels.

Even when subjected to high input signal levels, the output distortion levels were low and well controlled. It was apparent that modifying the frequency response did not result in generating new or disturbing distortion products.

Listening tests

After identifying what the Vivid 3D Plus system actually does, I decided to take it home and evaluate its subjective performance with both mono and stereo input signals. Connecting the unit up proved to be delightfully simple, and I took the output from my preamplifier's line output socket through the Vivid 3D Plus and its special cables into my power amplifier's output sockets.

I did discover that the miniature tip ring and sleeve stereo output socket may not have been the most appropriate choice, as it displayed some intermittency in its contacts. However that may have been the result of prior abuse before I received it.

With the system installed and mono signals being generated by the mono control on my preamplifier, I selected the 3DM operating mode. Comparing the output of a new disc with Highlights from The Barber of Seville (Sony SMK 53501), I chose track four, with some exquisite singing by Marilyn Horne.

In the original stereo mode, the stereo imaging was well defined, and the positions of the individual singers could be readily identified. In the mono mode with the signal processed by the 3DM circuity, the effect was entirely different.

The sound had an obvious spatial component, but it was different. Had I not embarked on an A-B test procedure, I doubt that I would have immediately picked the difference. Various members of my family could not pick the difference until the A-B test was repeated.

The performance in the 3DM mode was sufficiently impressive for my son to offer the opinion that this system has obvious attributes with his computer games, and could he borrow it. I declined his kind offer, and moved onto the next stage.

With the SRS mode selected, I played a new set of discs from Joseph Haydn's 'The Creation', with Bruno Weil and the Tafelmusik playing on period instruments (Vivarte - Sony Classical SX2K 57965). With the SPACE control set to +45° and the CENTER position at the zero setting, the resulting audible change was quite remarkable.

The sound field had unmistakably broadened out. The music sounded a little different in its balance, but the sound was inexplicably 'richer' and more mellow. I could identify the presence of musical instruments on a significantly broader sound stage. It was as if my left speaker had moved approximately 1m to the left, and the right speaker had similarly moved 1m to the right.

But too much of a good thing is not always good for you. In this case, too much can be positively disturbing. As I advanced the SPACE control further clockwise, the spatial enhancement of the sound became less well defined, and it became blurred. Instead of being a pleasurable improvement in quality, it became decidedly unpleasant, and I soon reverted to a less dramatic degree of spatial enhancement.

Activating the CENTER control similarly achieved an enhancement in the balance between the centre stage signal and the stereo images that were created by the left and right channels. Whilst the CENTER position may have some value on some discs, it was my perception that it offered lesser advantages, and certainly less significant attributes than the SPACE control.

I decided to move my two speakers closer together (approximately 1m apart), and to repeat the exercises of adjusting both the SPACE and CENTER channel controls. To my surprise, I found that with closely spaced speakers, the SPACE control achieved a broadening of the sound stage out of all proportion to what I would have thought was achievable.

Having heard, and more importantly having appreciated what I had heard, I began to understand why the more expensive Sony and RCA TV sets offer the SRS option. This is a decidedly attractive way of making a small room into a big room, or a small TV or hifi system perform like a more widely spaced or larger system.

Summary

The Vivid 3D Plus 3DM concept works. It works well with mono signals of the type which your computer games currently generate, and if you are a computer enthusiast then you really ought to listen to the Vivid 3D Plus, because it will do wonders to your system.

The Vivid 3D Plus SRS system also works. On some music it creates images which are exciting and aurally rewarding. When used judiciously, and with modest advances of the primary controls, the sound is not unlike that which is provided by a good DSP system. Unlike the DSP system which retains its original audible sound stage depth, the broadening of the sound stage by the SRS system is incomparably superior. And of course you don't need any additional speakers or amplifier channels...

Some prospective purchasers will immediately fall in love with the Vivid 3D Plus, particularly if they are not 'purists'. At $199, this is one product that you should audition, as it can do wonders to your system.

The Vivid 3D Plus measures only 127 x 100 x 30mm, and weighs 190 grams excluding the 12V power pack. Further information is available from the Australian distributor, Company 29 Pty Ltd, of 12A Kylie Place, Cheltenham 3192; phone (03) 532 5929. ❖

NEW BOOKS

Auto electronics

AUTOMOTIVE ELECTRONICS HANDBOOK, edited by Ronald K. Jurgen. Published by McGraw-Hill, 1995. Hard cover, 241 x 192mm, over 670 pages. ISBN 0-07-033189-8. RRP $215.

As the editor of this book notes on the back cover, electronic devices and systems are transforming the automotive industry, and soon about 15% of every car's value will reside in its electronics alone. This makes auto electronics a very important and topical subject, as our own regular column has shown.

This new book is aimed at providing a comprehensive and detailed handbook on the current state of the art. Each of its 32 chapters has been written by one or more acknowledged experts in the field concerned, and they cover not only virtually everything in the modern car's electronics systems, but quite a lot of what's coming in tomorrow's vehicles.

There are chapters dealing with each kind of sensor and actuator, others dealing with microcontrollers, engine and transmission control systems, braking, traction, suspension and steering control, and still others with on- and off-board diagnostics, instrument panel displays and multiplex wiring systems. In the 'Emerging Technology' section there are chapters on navigation aids and intelligent highway systems, electric and hybrid vehicles, noise cancellation systems and future vehicle electronics.

It's certainly comprehensive, and up to date. The material is both detailed and authoritative, as well, with valuable glossaries and bibliographies.

Frankly it's the kind of book which has been sorely needed, and should make an essential reference for anyone who needs a sound understanding of this subject.

The review copy came from McGraw-Hill Australia, of 4 Barcoo Street, Roseville 2069. (J.R.)

Shortwave listening

PASSPORT TO WORLD BAND RADIO 1994. Published by International Broadcasting Services (IBS), 1993. Soft cover, 177 x 254mm, 432 pages. ISBN 0-914941-30-5. RRP $34.95.

Shortwave radio listening has been around almost as long as radio, and it stands to reason that there is now an almost unlimited number of services available. Hence the need for this book.

Although it contains lists of radio stations, their location, transmitting power, times of broadcast, language and so on, I was pleased to find that the opening pages of the book explain what to do if you have never tuned into a shortwave broadcast before. In fact, there's quite a lot of general interest material.

There's also quite a large section on choosing a suitable radio, including a rundown on virtually all the digital portables currently available. Unfortunately, being a US publication, everything is relative to the US market.

The section that will probably interest those first getting into this activity is called First Tries: 10 Easy Catches. This refers to those broadcasts (in English) that will be relatively easy to 'flush out' and interesting to listen to. Here you can find out the broadcasting time and frequency of a major service, like the BBC World Service, as it applies to your location (like Australia and New Zealand).

Then there's an hour-by-hour guide to world band broadcasts. Brief details of each service are given, including news broadcasts, music, discussion and so on.

To this reviewer, *Passport* is an essential companion for those into world band radio. Recommended!

The review copy came from Craig Tyson, Contributing Editor. It is sold by Dick Smith Electronics and is probably available from other suppliers, including technical and larger bookshops. (P.P.)

Valve data books

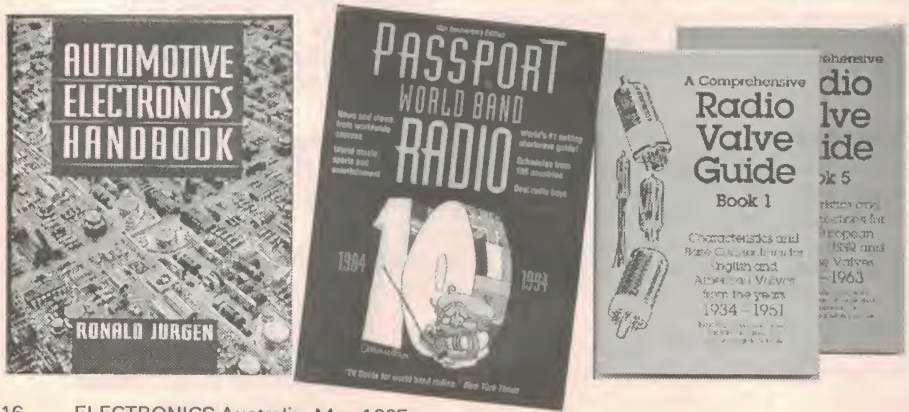
A COMPREHENSIVE RADIO VALVE GUIDE, BOOKS 1-5, and HANDBOOK OF RADIO, TV, INDUSTRIAL & TRANSMITTING TUBE & VALVE EQUIVALENTS, published by G.C. Arnold Partners, 1994. Soft covers, 210 x 146mm, around 50 pages each volume. ISBN 1 898805 + 01 6, 02 4, 03 2, 04 0, 05 9 and 06 7. Price by airmail £3.90 each, or £21.50 for the complete set.

The resurgence of interest in restoring vintage radio equipment has understandably brought with it renewed interest in data on thermionic valves (AKA 'vacuum tubes'). This has prompted Geoff Arnold and his partner, who publish the well-known British vintage radio magazine *Radio Bygones*, to republish this series of handy valve data books which were originally published back in the 1950's and 60's by Bernard Babani.

The books are nicely reprinted, and collectively cover both English and American valves produced over the years from 1934 to 1963. And while they're not full-scale valve data books with characteristic curves, etc., they certainly provide all of the basic electrical data plus base connections — which should be all that most people will need, nowadays. The base connections for each valve are on the same pages as its data, too, for ease of use.

In short, the books are likely to be of great interest and value to anyone involved in restoring or repairing valve-based equipment. This kind of data isn't easy to come by, any more!

The review copies came from the publisher, who can supply them direct by airmail for the prices quoted (Sterling). Their address is 9 Wetherby Close, Broadstone, Dorset BH18 8JB, England; phone/fax +44 1202 656474. (J.R.) ❖



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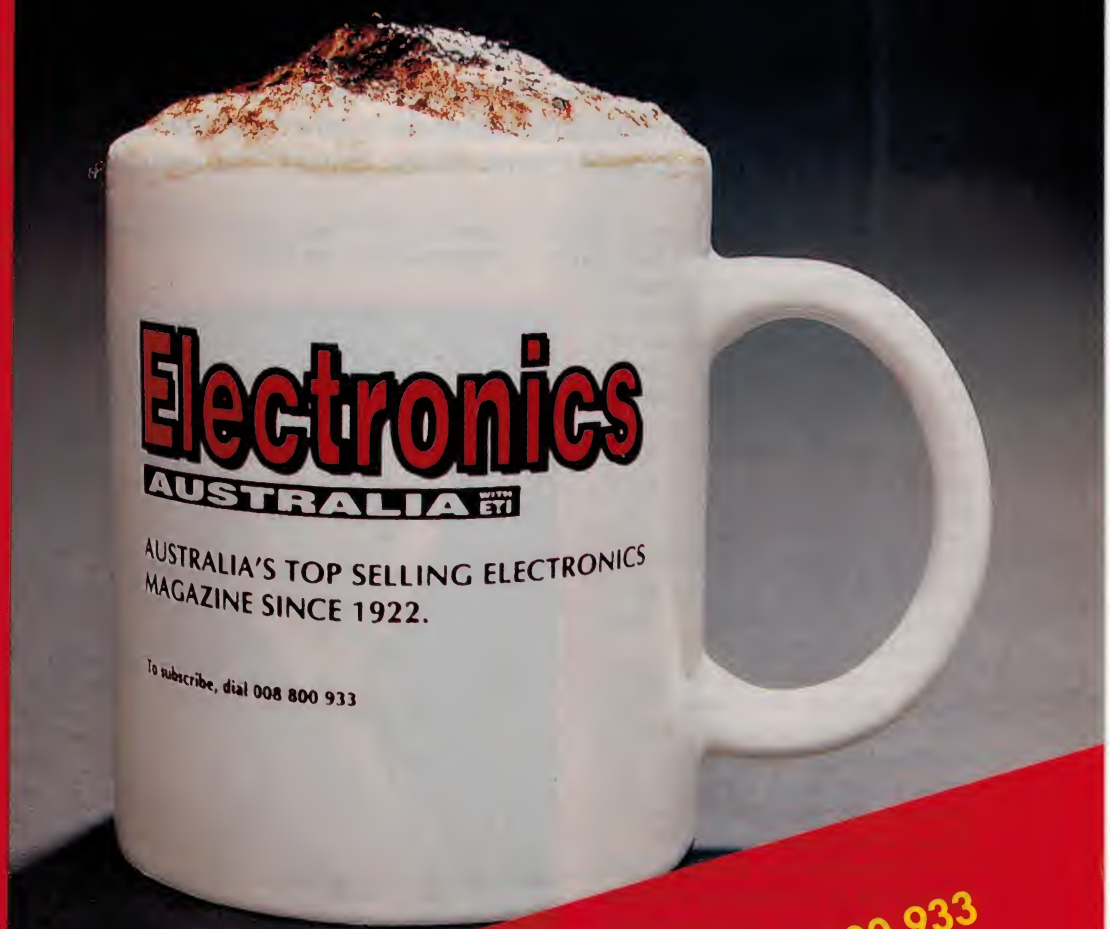

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When I Think Back...

by Neville Williams

Radiovision: 'TV' of a kind for Melbourne — twenty-five years ahead of its time!

Some time back, a reader inquired as to who had been broadcasting Baird-style visual signals in Melbourne around 1930. The appropriate answer, it seems, was a company called 'Radiovision', headed up by a certain Donald Macdonald — who had been around the Australian wireless industry since the pioneering days of Father Shaw, Ernest Fisk and John Balsillie.

During the decade leading up to World War I in 1914, pressure had been building on the Australian Government to set up wireless communication facilities to increase the reach of the PMG Dept and the Royal Australian Navy, and to improve communication between the various Empire countries. Key technical figures at the time were Father Shaw with a wireless factory at Randwick, Sydney, and Ernest Fisk acting as the local representative of an unlikely duo: Marconi (England) and Telefunken (Germany).

Faced with having to make major policy decisions, the Government of the day had to rely on the advice of independent experts, who were few and far between at the time — one notable figure being Graham Balsillie.

A Queenslander, Balsillie had headed off to England in 1903 to study electrical engineering. While there, he devised a magnetic detector and joined a company erecting wireless telegraph stations in England and Russia. He later worked in Germany, Siberia and China, before returning to England, where he formed the British Radiotelegraph Company to market his own 'Balsillie' system of radiotelegraphy.

In London in 1911, Balsillie met the Australian Prime Minister Andrew Fisher, who invited him to return to Australia to supervise the planning and installation of a network of wireless stations for their 'Communications Department' — the PMG.

Fig.1: Born in 1883, Donald Macdonald's lifespan embraced the very earliest years of wireless/radio in Australia. He also oversaw the development of the early domestic superheterodyne radio receivers and anticipated the introduction of facsimile and television.

By 1914, Telefunken and Balsillie radiotelegraphy stations had been erected for the PMG system at or near Port Moresby, Thursday Island, Cooktown, Townsville, Rockhampton, Brisbane, Sydney, Gabo Island, Melbourne, Hobart, Mt Gambier (SA), Adelaide, Esperance, Perth, Broome, Roebourne, Wyndham and Darwin; these plus King Island in Bass Strait were taken over from Father Shaw.

I must confess that John Balsillie's precise role in guiding the expansion of Australia's R/T services for the PMG was unknown to me, until brought to my notice by Ann Moyal's excellent book *Clear Across Australia* (published by Thomas Nelson Aust).

Donald Macdonald

I must also confess that I had not previously encountered the name of Balsillie's wartime assistant, Donald Macdonald, around whom this article centres. I am indebted to his surviving — and youngest — son Robert for a copy of his curriculum vitae, as compiled in 1926.

Born at Ascot Vale, Victoria in January 1883, and after normal primary education, Donald Macdonald studied electrical engineering at the Melbourne Technical College from 1900 - 1903. This was followed by a couple of positions as an electrical mechanic in a small business environment, after which he established a modest business of his own majoring on X-ray work (1905 - 1907).

In the latter year, Macdonald joined the PMG Dept, working his way from an instrument fitter to engineer in the Telephone Department, Melbourne (1907 - 1912).

In 1912, he was regraded to Wireless Engineer, Central Staff PMG Melbourne (C'wealth of Aust.). From this position, in 1914, he became Officer Commanding Wireless, Western Pacific, responsible to the Administrator in Rabaul.

In this situation, Donald Macdonald was clearly complementing Balsillie's commission mentioned earlier — the more so when Macdonald was assigned to the Permanent Naval Forces as an engineer, with the rank of Lieutenant Commander. As such, he became officer in charge of all Naval Wireless in the Western Pacific. He resigned from the Navy around 1921, with a view to embarking on a private commercial career.

In the same period, Macdonald visited England and America, intent on pursuing the advances in technology in those countries, and especially the emergence of public broadcasting. He had ready access to American entrepreneurs and pioneers, including V.K. Zworykin, Jenkins, Alexanderson, Firth, Captain Ranger and Colby, plus key personnel in the film industry. Said his son: "In his contact with such prominent people, he wasn't short of things to talk about, himself!"

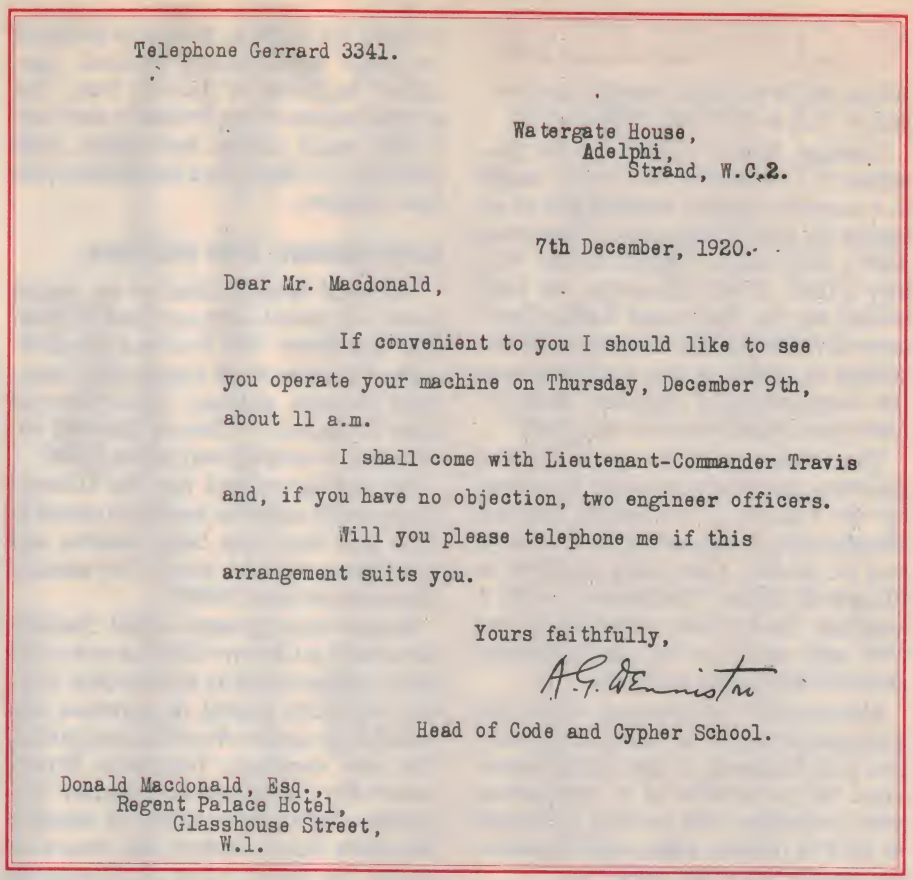
During the visit, he was able to negotiate the sale in the US of Balslillie's 'Flatlite' patents, and was invited to witness the trials of early radar navigation systems in New York Harbour in 1921. He also turned down an offer to join General Electric, preferring to pursue his career in his homeland.

In 1922, Macdonald set himself up in the Equitable Building in Collins Street, Melbourne as a Consulting Radio Engineer and, as such, spread his attention from telegraph stations in the Pacific to the new public broadcast stations which were being envisaged for Australia. So ends his own 1926 career summary, recovered from his personal papers.

A generation gap!

In an aside, Robert Macdonald remarked to me rather sadly that he could only read about his father's career. Even in 1926, as the youngest child, he was 'still a kid' and not really able to appreciate much of what his 'dad' was on about.

He has since discovered that his father went to New Guinea with the ANMEF Contingent, to assume control of German wireless installations in the Pacific. He organised the commissioning of the station at Bita Paka near Rabaul, and recommissioned the one at Nauru. Other stations were constructed at Woodlark Island and at the Headquarters in each district in PNG.



Telephone Gerrard 3341.

Watergate House,
Adelphi,
Strand, W.C.2.

7th December, 1920.

Dear Mr. Macdonald,

If convenient to you I should like to see you operate your machine on Thursday, December 9th, about 11 a.m.

I shall come with Lieutenant-Commander Travis and, if you have no objection, two engineer officers.

Will you please telephone me if this arrangement suits you.

Yours faithfully,

A.G. Denniston

Head of Code and Cypher School.

Donald Macdonald, Esq.,
Regent Palace Hotel,
Glasshouse Street,
W.1.

Fig.2: Macdonald's cyphering machine, developed towards the end of WWI, was important enough to warrant personal inspection by Britain's top cypher expert. Macdonald later refused an offer of £10,000 from the Japanese Government.

All told, and by the end of the 1930's, says Robert, his father had evidently been the engineer responsible for the construction of more than 40 wireless stations of one kind and another.

By contrast, early in his career, he had developed a cyphering machine which anticipated Germany's revolutionary 'Enigma' system by about six years. After each transmission, the cypher could be scrambled in a random manner, adding immensely to the difficulty of an eavesdropper breaking the code on any given occasion.

His research came to the attention of a Secret Service Unit involving codebreakers and cryptographers, under the control of the British Admiralty. Set up in Watergate House in Adelphi, the so-called GC&CS (Government Code & Cypher School) had become operative in 1919 under Alistair 'The Little Man' Denniston.

Within a couple of years, however, the group became answerable to the British Secret Service and the War Office rather than the Navy, with cryptography becoming a tool of international politics and diplomacy, rather than an instrument of war.

As noted in the letter reproduced herewith, Donald Macdonald was invited to demonstrate his cyphering machine to Alistair Denniston in person. Nothing came of the matter, however, because the war was over, and Donald Macdonald was uncomfortable about the casual attitude of British and Australian diplomats to Japan. His own experience in the Pacific area had convinced him that Japan could pose an ultimate threat to Australia, next time around, and he was not prepared to support any action which might upgrade Japan's then relatively transparent cryptography.

Not surprisingly, when the Japanese Government offered him £10,000 for access to his cyphering machine in 1920, their approach was rejected. Says his son Robert: "The course of World War II might have been different, if Japan had installed an encryption system which the Allies were less able to decipher!"

Broadcast stations

In the mid 1920's, as mentioned, Donald Macdonald turned his attention to public broadcasting, acting as a consulting engineer for Associated Radio (3AR Melbourne), Central Broadcasters (5CL Adelaide) and Tasmanian Broadcasters (7ZL Hobart) in 1926. His last in-

Fig.8: Designed in Melbourne for local sale or home construction, a RTL Labs facsimile receiver designed to be fed from a radio set in lieu of the loudspeaker.

and service centre in Wingello House, Angel Place, Sydney. It would be managed by Don Knock.

Their receiver range was said to include a 4/5-valve metropolitan model, a 5/6-valve country model and an all-wave design, which might well have been the first of its kind on the local market. The receivers would be supplied complete or chassis only.

As I remember, Don Knock wrote his share of technical articles and was very active in the amateur ranks — but was not, to my knowledge a marketing man, likely to re-write Radiovision's fortunes.

So what happened to the company? In fact, I found the apparent answer in one of Donald Macdonald's clips, from *Smith's Weekly* for November 28, 1932.

Under the heading 'Will we soon be seeing things in our radio sets?' it says that Maguire Television Co Pty Ltd and Radiovision (A'Asia) Ltd had merged, to set up Teleradio Construction Pty Ltd (Inc. September 23, 1932), to take over the business of manufacturing and selling radio receivers from Radiovision's present address: Margaret Street, Richmond.

The very wording of the heading perpetuates the flawed notion of television as a kind of peep-show, supplementing an otherwise ordinary radio program. The article gives no information about the Maguire system, beyond the fact that it did not involve the use of a scanning disc.

In the Melbourne *Herald* (February 23, 1933) an abridged prospectus for the Radiovision partner stated that it now held priority rights to the Maguire system, adequately covered by Australian patents.

It was described as a compact cathode-ray system which produced an image on a fluorescent screen. Donald Macdonald's name appeared among the directors — minus any mention of a Managing Director.

A letter among his papers, signed by the Company Secretary, says that on May 9, 1934 his fellow directors had passed a motion recognising his dedicated service during a difficult period marked by a conflict of opinion, by limited funds, ill health and 'crushing family misfortune'.

A major shift in Macdonald's — and the Company's — concept of the subject was apparent in an article written by Macdonald on 'Television', in *Listener In* for May 19, 1934. It explained the principles of contemporary television based on cathode-ray technology developed by Dr Zworykin — another of his early contacts.

Donald Macdonald and the reconstituted Company were on the right track at last, although they could not have foreseen the intervention of WW2, the enormous scale on which television was to expand in its own right, the on-going hassles over international standards, and the ultimate dominance of the industry by manufacturers in Japan and South-East Asia.

Freed from his everyday commitments at Radiovision/Teleradio during the latter part of the decade, Donald Macdonald became involved in developing medical equipment, audiometers, colourimeters, recording oscilloscopes and X-ray equipment.

He also developed a system for photoelectric grading of dried fruit, to replace the cumbersome manual systems. A training studio was also set up for would-be radio performers, but it was not commercially successful.

Donald Macdonald died of a heart attack in 1946, while developing special techniques for the drop forging industry.

He was a multi-skilled electrical engineer from Australia's radio history, who thoroughly deserves a place in these pages. To his son Robert, who made this article possible — thank you! ❖

The latest advances in digital photography:

MEGABYTES AND F STOPS

In many photographic circles, the conjecture continues: will digital imaging replace conventional silver-based photography? However, for many organisations there is now no purpose in further speculation — they are too busy using their digital cameras!

by BARRIE SMITH

One of the difficulties in producing this story was encountered in the research stage: looking for 'hands on', user comments about the technology. I found that some organisations would not respond, remark or even comment on their work with digital cameras.

One Melbourne company — Showads — has had nine devices in service for two years. Its output includes full colour brochures and catalogs for the consumer market. By keeping its activities under a cloak, the firm's principals aspire to keep ahead of the opposition; for them and other closemouthed competitors, digital photography is a viable, commercially profitable approach to high quality image capture.

The range of digital devices available on the Australian professional market now covers nearly as many formats as conventional film cameras: 35mm, medium format and up to 4 x 5. No matter whether your output is 6 x 9cm business portraits or A3 posters, there is now an instrument to service that need.

By the way, I use the word 'device' advisedly. Some units are actually digital backs, designed to be attached to camera/lens front ends; others are complete entities, with the image sensor and processing circuitry built into a conventional camera.

Digital 4 x 5

Possibly the most impressive unit currently in use is the Dicomed 4 x 5 digital camera back. Nominally able to replicate a 4 x 5 camera's output (exposed area of 96 x 120mm), the unit has an actual maximum image area of 72 x 90mm. The charge-coupled device (CCD) sensor is 72mm wide, using three rows of sensors for red, green and blue (R, G, B) which are scanned in a single pass.

Using 12-micron pixels, its CCD delivers a maximum of 6000 x 7520 pixel resolution in 36-bit colour. The sensor's dynamic range covers more than eight f-stops, enabling its US maker to describe it as having 'reproduction quality superior to 4 x 5 film'...

The back, only 16.5mm thick, loads in similar fashion to a 4 x 5 film back. Focusing and composing can still be done on the camera's ground glass back as the digital back slides into the same focal plane.

Because the Dicomed sensor's image diagonal is 75% of film coverage, a little adaptation is needed by the photographer in lens selection — a 90mm lens becomes a 120mm, in terms of view angle. Further, the actual exposed image area is selectable right down to 1% of the maximum. The latter size results in a 2MB

With a 129.1MB file size, the Dicomed digital back is head on with conventional 4 x 5 silver based film imaging.

volvement in this field was the construction of 3LK in 1937 and 7EX in 1938.

Amongst D.M.'s papers was the facsimile of a document which was sealed in a concrete capsule, forming part of an anchor for one of three cables supporting 3AR's 200ft mast. Erected on the Victory Estate, North Essendon, on land owned by the Associated Radio Company of Australia Ltd, the purpose of the station as stated in the document was 'the broadcasting of telephony news information, church services and music'.

The document was signed by the directors and others involved in setting up the station — including Donald Macdonald. It mentions, by the way, that the studios were being installed in Elizabeth Street, Melbourne, with a landline feed to the transmitter and with easy access to the City's principal churches and public buildings.

Macdonald's involvement with 7ZL was quite different. He had a sentimental link with Tasmania, in that he had supervised the installation of a communications transmitter and receiver in Hobart in 1912 to provide a link with the Mawson expeditions to the Antarctic.

Twenty or more years later, with the introduction of public broadcasting, he circulated a private letter to Tasmanian investors whom he judged might be interested. In it, he made the point that Sydney and Melbourne had each been granted the right to two high-powered 'national' broadcasting stations, supported by listeners' licence fees. The smaller capitals were limited to one such station under current regulations, with Hobart's 7ZL being in a particularly parlous situation.

Low power, low income

7ZL had been limited to an output power of 1/4-kilowatt and had to compete for about 800 licensed listeners, many of whom were attracted by mainland stations, anyway. Total revenue from all sources — licence fees and advertising — totalled only about £1200.

He had ascertained that the Government would authorise increased power to 3kW and this, with better studios and facilities, should boost the annual revenue to at least £6000.

Present management would consider favourably a takeover bid by a new company, compensated by a share deal, leaving sufficient capital to purchase and install high quality American equipment. The new company, Tasmanian Broadcasters Pty Ltd, would have mainly Tasmanian shareholders, would be based in Elizabeth Street, Hobart and would be under his supervision as Managing Director, reponsible for both business and technical management.

However, while there is no reason to believe that Donald Macdonald was ever dismissive of his obligations to everyday radio technology, as above, there is little doubt that he was more fascinated by the notion of transmitting *images* rather than sound from place to place by landline, cable and/or radio techniques.

It is evident, according to his son, that having met overseas inventors/pioneers during the early 1920's, his father had made a point of keeping in touch with them in later years, eagerly sharing their ideas and their enthusiasm for tomorrow's technology.

In September 1928, he circulated Vol.1 No.1 of a publication called *Radiovision*, on behalf of TRL (Television and Radio Laboratories Pty Ltd) of which he was Managing Director. Although described as a 'monthly journal', the photostats I have of Vol.1 comprise a single sheet folded to provide four pages, to be posted to the recipients. The intention was to change to a more ambitious format later, but this was never realised.

What it was all about

The first issue carried an explanation of the title, 'Radiovision'. 'Television' dated back to the 1880's, it said, when vision-related signals were first conveyed by telephone line and descibed as 'television'.

One of Macdonald's pioneer contacts, C. Francis Jenkins of Washington, had suggested that this terminology be adopted but that vision signals through space should henceforth be referred to as 'Radiovision'. So that became the title of TRL's journal, and in 1930 of the company itself.

Vol.1 No.2 (October 1928) carried an elementary explanation of 'Seeing by wireless', and listed eight stations in the USA that had been broadcasting experimental radiovision signals for up to six months. They varied in carrier frequency, picture rate and the number of lines, but details of the first station to air were as follows:

3XK, Washington, D.C., Jenkins Laboratories, 46.7 metres, 6420kHz. Forty-eight lines per picture. Fifteen pictures per second. Monday, Wednesday and Friday, 8 to 9pm, Eastern Standard Time. Radiomovies.

Vol.1 No.3 featured the text of a lecture by C. Francis Jenkins, whom it identified as 'the inventor of the motion picture projector', as well as a pioneer of Radiovision with achievements in that field dating back to 1913. At the time of the lecture, Jenkins' Radiovision station, as above, had been active for about six months.

A separate item in the same issue (Nov 1928) noted that the PMG had decided to set up a picturegram facility between Sydney and Canber-

Fig.3: From EA December 1969, this picture shows Gil Miles operating transmitting equipment developed by Radiovision for what was effectively an early version of modern day fax.

ra, to be extended later if commercially warranted.

In December 1928, the editorial highlighted — and ridiculed — a statement by the Director of Postal Services (Mr Brown) who had warned citizens against investing in companies promoting television or radiovision services. The editorial insisted that the publishers of *Radiovision* magazine were not cranks, but were merely following the lead of their American counterparts who had been featuring the new technology for the past six months.

Pictures by radio

Two 'epochs in a new era' were announced in Vol.1 No.5 (January 1929), the first being that Television & Radio Laboratories Ltd had commenced experimental Radiovision transmissions through Melbourne radio station 3UZ a few days before, on January 10. It had also been announced in the press that station 3DB would be radiating test transmissions of the Baird system 'during next week'.

(At this point in time AWA had a nominal interest in picture transmission, as Australian representative of the European Fultograph system. According to a report by A.K. Box in *Popular Hobbies* (December 1, 1930, p.15) the two companies had merged their interest in the technology to achieve uniformity in broadcasts by 3UZ and 3DB in Melbourne, 2UE in Sydney and other unspecified interstate stations.)

Some of the images being transmitted by 3UZ were illustrated in the February 29 issue. To the question whether such images could be a source of enjoyment, the editor insisted that the real reward of radiovision was in appreciating how the images were produced, especially with the illusion of motion!

In different vein, the issue also announced that the PMG had accepted a tender from British General Electric for the supply of apparatus for the new Sydney-Melbourne picturegram link. T&R had missed out, on what they described as 'another progressive step in the march of radiovision!'

The following issue (March 1929) carried assurance that T&R Labs would be manufacturing neon lamps locally, in time for hobbyists to complete a radiovision receiver — for 3UZ, 3DB — 'before the long winter evenings are with us'.

It also mentioned that the committee responsible for the forthcoming radio exhibition had decided to exclude radiovision apparatus, lest it convey the impression to the public that the service was much closer than was actually the case.

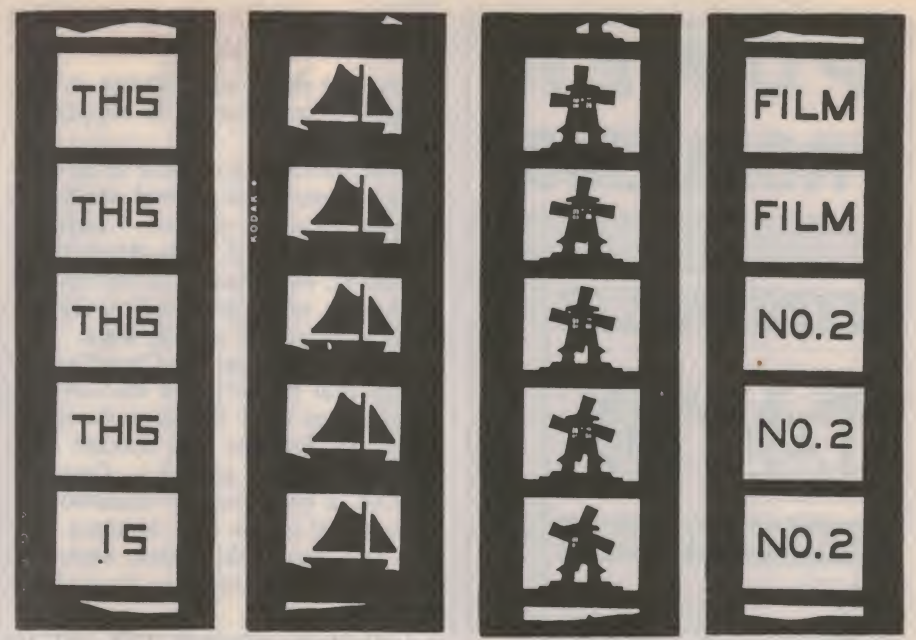


Fig.5: Radiovision shapes could be transformed into 'moving pictures' by using a moving model or by transferring the images to movie film as above. (See also EA for December 1969 and July 1972).

Radiovision for April 1929 challenged the Government to develop the technology for Australia, for its potential value during wartime. The May issue featured snips from films used to create moving images for the 3UZ transmissions.

A super optimist

In the last but one of the issues of which I have a copy, August 1929, the Editor points out that, despite the contrary opinion of experts, public demand had replaced traditional 'silent' films with 'talkies' in cinemas during the past three years. A similar reaction could be expected once the public realised that it was now possible to add a picture to radio sound.

The writer conveniently ignored the fact that talkie sound technology was sufficiently advanced to complement the picture, whereas continuous motion 'radiovision' technology was still in its infancy.

With hindsight, the *Radiovision* publication to hand reflects — to this writer — fifteen months of futile 'wishful thinking' on the part of T&R Ltd management.

The irony of the situation was that, about this very time T&R had assembled a team of capable engineers to head up their production of conventional receivers, comprising Howard Kingsley Love, Lay Cranch and Gil Miles. As recorded in Lay Cranch's biography (See *EA*, June 1994 p.41) they had developed an autodyne superhet of the very type which helped launch the 'golden age of radio'.

Equipped with just such receivers, countless thousands of families across Australia would gather round the radio each evening listening to plays, amateur

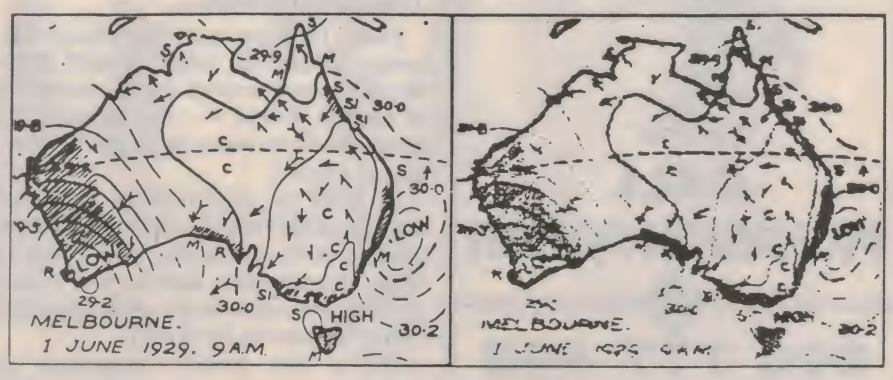


Fig.7: An original weather map (left) and as received on TRL equipment from 3UZ (right). It would be useful to farmers, without any accompanying sound!

WHEN I THINK BACK

hours, quiz shows etc., drawing on their collective imagination to supply the visual aspect!

A quarter-century or more of developmental systems and a world war had to happen before the nations — including Australia — could settle down to the standards, equipment and conventions necessary to support radiovision — sorry, television — in every home.

It is apparent from Lay Cranch's biography that he believed Radiovision management to be headed in the wrong direction. Both he and Howard Love resigned, or were pushed — Cranch to 'rescue' a rival receiver manufacturer, Love to set up his own company. This was at a time of depression, when both would have been cautious about changing jobs!

(Gil Miles remained with TRL for some time, having been involved with the radiovision equipment — the kind of experimental work that intrigued him).

Diversity of opinion

When I put it to Robert Macdonald that Love and Cranch could see where Radiovision was going astray, he tended to agree.

Yes, it did appear that his father had been unduly influenced by pioneers like Jenkins and Baird, and genuinely believed that Australians should generate expertise — and patents — such that we would not be dependent on overseas when radiovision/television became a reality in the near future. ('Within a year' — *Radiovision*, October 1928.)

And, yes, there appeared to have been a diversity of opinion at management level about planning for this hypothetical future. Some contended that they should undertake conventional receiver production to provide funds to meet current needs!

Troubled times

From 1930 onwards the picture becomes confused, with Donald Macdonald a controversial figure, according to his son Robert — often opposed by associates from whom he might have expected support.

In 1930 he experienced personal tragedy, in the loss of a sister in the then-current polio epidemic, and a son in 1931. Just ten years later he was to lose another son, shot down over Germany during a sortie by the RAAF.

While the public response to electrovisual technology fell short of Macdonald's expectations, his clippings from the Victorian press indicate that the concept lingered on.

Popular Hobbies dated December 1, 1930 carried an article by 'AKB' — presumably A.K. 'Boxie' Box, whom I recall, amongst other things, as technical editor of *The Listener In* (see earlier reference).

Essentially, it repeated Macdonald's theme from the 'Radiovision' bulletins, stressing that the technology was simple but capable of elaboration, and that the present time slot for its introduction was 'fortuitous'.

In due course, stations would be able to transmit sound signals to accompany the pictures. In the meantime, diagrams like weather maps did not need a sound signal, and could be studied to advantage by farmers a whole day before they appeared in the morning papers.

Elsewhere in the issue was an article by Macdonald discussing the construction of an adaptor to convert signals from a normal radio receiver into a printout.

In September 1930, picture transmission grabbed the headlines again when an acceptable half-tone photograph broadcast by 3UZ was captured by a radio enthusiast in Ballarat and featured in the local paper *The Ballarat Courier*.

A world record?

A few months later, in November 1931, a picture of the winning horse in the Melbourne Cup was telegraphed to newspapers in both Sydney and Brisbane, the latter representing what may well have been a world record for distance and transfer time.

The Lay Cranch biography, mentioned earlier, featured a newsworthy event in 1932, when another rider on another horse slashed the ribbon at the official opening of the Sydney Harbour Bridge.

To the public at large, such items tended to confuse the methodology and parties involved. But they entrenched the notion of seeing at a distance — by electrical means — with Macdonald and Radiovision at the epicentre.

So what happened to Radiovision (Australasia) Ltd? Early on, I put this question to Darryl Kasch of Maryborough in Queensland, who has been cataloguing Australian radio manufacturers. Said he: "I really don't know. They seem just to have disappeared"!

A month or so later, he forwarded me a lone photostat from *The Radio Retailer of Australia* for July 1932, indicating that Radiovision A/sia Ltd were planning to set up a distribution

(megabyte) file size, while a full area exposure can tot up no less than 129.1MB — a dimension of some bulk, especially when computer downloading and subsequent software manipulation are taken into account.

A span of eight shutter speeds is available: from 1/8 sec to 1/40 sec. With the Dicomed we're not talking 'fast action'! However, workers in 4 x 5 and other large formats rarely call on faster speeds, selecting longer exposure times to allow smaller lens apertures.

The Dicomed back can be driven from 12V battery power or universal voltage AC current. Supplied with the back, and linked to it via a dual SCSI chain is a 1GB (gigabyte) drive, with storage capacity enough for seven full resolution exposures.

Big file sizes and relatively small hard drive storage give many photographers, new to the technology, pause for thought. But in the real world, much smaller file sizes can be employed, depending on the final output required. In like fashion, there is no point shooting a 4 x 5 film negative to output a passport photograph...

The software supplied with the Dicomed is the key to this situation. In extracting the required performance level from the device, careful control of exposure, contrast range, colour balance and output level must all be tweaked via a PC. The most common computer interface used for this to date has been a Macintosh (virtually of any sort), but Windows platforms can now be interfaced as well.

It is quite feasible to run the 'camera' from a Mac PowerBook with a mono LCD screen, shooting colour subjects. To take a photograph you first focus the subject, take a light meter reading and set the lens aperture. At this point, via the software, a 'prescan' is triggered, giving a rough screen representation of 60 kilobytes. Control data such as colour temperature, ISO speed, shutter speed (called 'line scan') and desired output resolution is then fed in.

As inferred earlier, selection of resolution level is critical. At 100% resolution, using the full sensor area with output at 300dpi, the camera will shoot a 129.1MB file. It takes 15mins to place the image on the hard drive, with the line scan shutter set to 1/8 second capture. However, lower settings and faster line scans drastically reduce file sizes and exposure times.

Hands-on test

Sydney photographer Mike Berceaunu made a test run with the Dicomed and when asked the hard question "Is it better than 4 x 5?", he answered:

"Got to be careful there... it doesn't cover the whole area of 4 x 5 film, but it covers enough of it to make it useful as a view camera — and it's the first digital instrument that allows you to use all of the view camera movements."

"Resolution? Yes it certainly has more than you would use in just about any application."

Phil George, who runs a fine art photographic course at the University of NSW, is convinced that "...the quality is better than 4 x 5 — at full res", adding that "those sort of issues are a bit problematic, because it depends on the device you're going out to. If you're going out to film it will resolve as well as most films, but these days you can go

FURTHER UPDATES

- Bronica, a long time manufacturer of 6 x 6cm SLRs, has entered the field of CCD cameras. The major difference with their Camphoto VX3000 is that the back 197 or 'head' — outputs a video signal in NTSC or PAL from its 1/2" CCD. The head attaches to a Nikon F4S 35mm camera body, so allowing conventional 35mm stills, live action video or video stills to be shot.
- A new high end digital camera will appear early in 1995, marketed by Agfa. The output file size is 24MB maximum, yet it's claimed that from the 24MB file an A0 size four-colour poster can be reproduced in high resolution...
- One of the limitations of digital photography was thought to be the capture area of the CCD. But with new stochastic screening technology, an image of acceptable quality can now be extracted from 10% of the final output size.

Above: Simultaneously marketed by Fuji and Nikon, the 505/E2 35mm format digital camera benefits from unity design and an optical path which allows correct focal length coverage.

Right: Kodak's DCS420 has 14 x 9.3mm CCD imager with 1.5 million pixels (1524 x 1012). The camera is able to shoot two frames per second in a five second burst, but inhibits wide angle lens photography.

out to electrostatic devices, thermal printers, etc."

He and his students rarely take 129MB shots: "Most of the time we're around the 20 - 40MB mark. 40MB is enough these days, good enough to match a very high quality 35mm trannie, or in fact a very acceptable 5 x 4."

Ian McKay of distributors Hanimex acknowledged that "...general photographers often say 'By God, it takes a long time'. In pure minutes it's still a short time, because by the time you've loaded sheet film and processed it and used the couriers and all the rest of it, our 15 minutes is a lot shorter. Anyway, how many times are you going to shoot a 129MB file? If you are shooting to finish at A4, with a 175lpi screen you are looking at a 30MB file with a 7min 31secs shooting time."

Kodak's DCS420

Around two years ago Kodak launched its DCS200, the first 35mm format pro digital camera. The front end was a Nikon 35mm camera body, backed by a Kodak manufactured CCD, delivering 24-bit colour.

In 1994 the DCS420 arrived, and found many friends. Its CCD imager is 14 x 9.3mm in dimension, packed with 1.5 million pixels (1524 x 1012 pixels). Now 36-bit capable (12 bits per RGB primary), the camera can capture at ISO equivalent speeds of 50 - 400 in colour. The DFCS420 has the ability to shoot two frames per second, in a five second burst. Audio 'notes' can be added via a built in microphone, and each remains linked with its image file. Image downloading can take 38 secs; the camera offers a DOS or Mac interface. Hard drive or PCMCIA cards are usually linked for storage. A 130MB PCMCIA card can store 78 images, each totalling 4.3MB in uncompressed form.

Rollei's Digital ChipPack uses a 2048 x 2048 pixel CCD and records 36-bit colour in three exposures, for a total of 12MB per picture. The back is designed to fit Rollei 6 x 6 SLRs.

The ODIS organisation in Sydney uses a DCS420 for business portraits, outputting to an E-Print digital printer. Final size of each image is limited to 6 x 9cm, the quality of which a company representative described as 'not too bad', but added "we used a few tricks with lighting initially, and had a few hassles with the lens' focal length".

The CCD sensor's diagonal measures 40% that of a 35mm film frame, so focal lengths undergo a 2.5x increase. A 24mm focal length lens becomes a 60mm, creating a major problem when wide angle coverage is required.

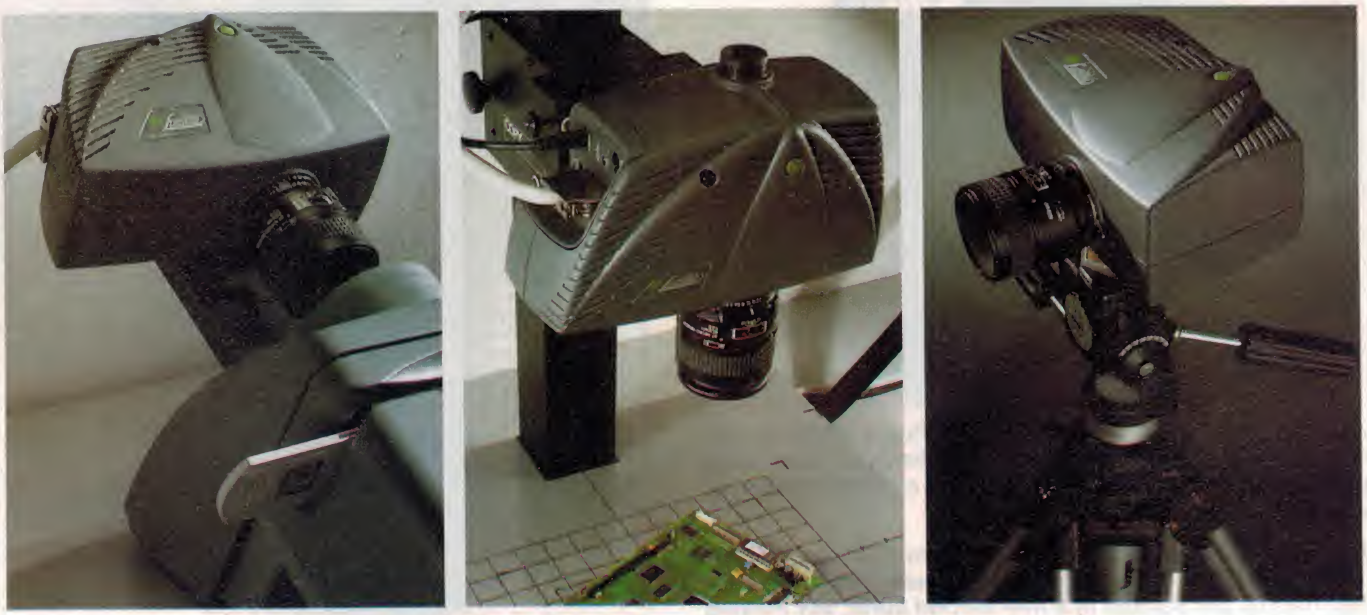
Some owners complain that not all the functions of the F90 can be accessed in this hybrid Kodak/Nikon device. The ODIS operator found he was "limited to certain modes, and it's quite complex — but once you've got it working well, it's quite a good camera".

The ODIS man also felt that exposure and colour control, via the PC and Photoshop, was "not all that great. You may have a day and a night setting, etc — but that's about all".

Photokina 94 saw the model DCS460 arrive, with a six million pixel CCD (3060 x 3060). This camera is capable of producing an 18MB file every 12 seconds. The price will be more than double that of the DCS420's. Interestingly, Kodak plan to use the higher capacity CCD in a large format back for the Sinar view camera, and the built-in microphone will follow with it — this writer is looking forward to seeing a commercial photographer talking to a 4 x 5 camera!

Fuji and Nikon

Into this (seemingly) happy US/Japanese collaboration has bounced the Fuji company, with a new 1.3 million pixel CCD (1280 x 1000). The CCD has been built into a newly designed Nikon body, similarly configured to the well known F4 model. This camera, due in Australia in early 1995, will be sold by Fuji as models



The Leaf Lumina camera, with Nikon lens mounting, produces a 26.1MB full scan image from its single pass CCD.

DS-505 and DS-515, and by Nikon as the E2 and E2s. The difference? The DS-515/E2s models can shoot a seven frame burst in three seconds.

Industry talk suggests that Nikon were not happy about Kodak's sourcing camera bodies from other than 'conventional' lines of supply, thus prompting the Fuji/Nikon liaison...

The upshot of the new approach is that the Fuji/Nikon collaboration attacks one of the Kodak-imaged DCS major foibles — true focal length retention.

The Fuji CCD has a 2/3" diagonal measurement — similar to Kodak's sensor. But in setting up the optical path, the designers have placed a condenser system between the taking lens and the CCD. The result is that a real world subject is now captured full size, with no cutoff. As the final image is now smaller, there is an increase in its illumination level — by three stops.

In use, the external Nikon taking lens is left at a wide open aperture and an internal aperture is used to control exposure.

Capable of film sensitivities equivalent to ISO800 or 1600, the CCD uses a new charge transfer technology, able to tap the full sensor area for image pickup. An external LCD display oversees metering modes, image quality settings and colour balance, claimed to allow manual selection of anywhere between 3000 - 9000K.

Five uncompressed images can be stored on a 15MB PCMCIA card; varying JPEG compression factors will allow the same card to store 21 'fine', 43 'normal', or 84 'basic' resolution images. Image files can be downloaded to both Mac and DOS platforms via an RS422 port, or displayed as a video signal on an NTSC or PAL monitor via an RCA connector. The price is likely to be competitive with the DCS420.

Secrecy

German company Rollei have two digital backs designed to suit the company's medium format SLR (single lens reflex) models.

Not much is known about the deployment of these units in the working world, as the best known operators of the devices are the Department of Defence and ASIO — bodies not known for their loquacity. As we all know, 'loose lips sink ships'...

Covering an area of 41.2 x 35mm, the Digital ScanPack is suited for use with Rollei 6 x 6 SLRs or view cameras. It can be coupled to Macintosh or DOS platforms, outputting 30-bit colour images in TIFF, RIFF, PICT, IMG and other formats. The sensor pixel array is 5850 x 5000, totalling nearly 30 million pixels. Built into the back is a three colour filter wheel, calling for three sequential scans to capture a full colour image. A minimum 8MB RAM is required; a 20-second 'Quickscan' over the full image is captured as a prelude to a full 30MB scan, which takes 2mins 30 seconds.

The company's Digital ChipPack uses a 2048 x 2048 pixel CCD, recording 36 bit colour in three exposures — a total of 12MB per picture. The back is designed to fit Rollei 6 x 6 SLRs and interfaces with Mac or DOS/Windows.

Leaf Lumina

An interesting 'beast' is the US-made Leaf Lumina. Barely larger than a Robert Ludlum novel, the device is a camera in the full sense of the word, fitted with a 35mm lens mount able to accept virtually any Nikon lens. The array is a single pass 1.75" CCD, 2700 picture elements wide per colour (RGB), scanning with 36-bit resolution in 3400 steps. A simple direct viewing, but focusing, viewfinder is inbuilt, while a full size 72dpi screen preview (on a Macintosh) is available within 20 seconds. The full resolution file of 26.1MB takes less than three minutes to acquire.

The company's digital back can be fitted to Hasselblad and some view cameras. Equivalent colour speed is ISO 25, in 14-bit colour depth. The triple-pass CCD array is 1.2" square and provides a resolution of 2048 x 2048 pixels. The final 12MB file can be taken to 50cm^2 on a 200lpi screen.

Another version, called Catchlight, operates at an equivalent of ISO 100 using a single pass CCD and permits faster shutter speeds, up to 1/1000 sec.

Pixellated future

Obviously, there is vigour in the digital photography market. Manufacturers are producing digital devices to supplant or complement conventional silver-based units. Camera companies such as Nikon are obviously keen to modify their product to accept the CCD imagers (as witness the Fuji/Nikon venture), while there seems to be little hesitation on the part of the CCD developers to boost pixel density.

There appears to be market activity, sufficient for at least some photographers to seriously consider investments of tens of thousands of dollars in digital capture. How long it will be before the digital revolution extends down into the consumer end of photography is anyone's guess, though. ❖

Moffat's Madhouse...

by TOM MOFFAT

The man who is NOT America's richest person

Destination: America.
Mission: dig up some articles for *EA*.
First port of call: Seattle, Washington.

What to do in Seattle? Well, how about a visit to the Boeing company? Trouble is, everyone else has already done that. Maybe I could take a different tack —like asking them why their 747 aircraft is so hard to control on the Microsoft Flight Simulator.

Microsoft... hmm. They're in Seattle, too. And Microsoft means Bill Gates! He's said to be America's richest man, and as chairman of Microsoft, he's seen as a visionary of computer technology of the future. Trouble is, we've already heard most of that; the Information Superhighway, computers that will talk and listen instead of communicating via keyboard and screen. All based on Microsoft's Windows, of course.

Still, Bill Gates would be a fine catch for the travelling journalist. Forget computers; what's it like to be the richest man in the USA? What's he eat for dinner? What does he do for kicks? How does he see the world in 50 years? What's Bill Gates going to be like in 50 years?

Yeah, we could have done a pretty good interview, but the whole idea hit the too hard basket when I read a newspaper account of another journalist's adventures in Seattle. He did achieve an interview, but before it could happen he was required to spend a full day at Microsoft's 'campus', undergoing what could only be described as indoctrination. Vetting of proposed questions; how to behave with Bill Gates. Only then was he allowed into the great man's presence.

That wasn't for me, because in the first place I never work with prepared questions. I prefer to get a good conversation going and then just wing it. This technique has given me excellent results with people such as every prime minister from Gorton through Hawke. It was good enough for them...

Maybe I could do an 'external' story — Bill Gates in Seattle, but without the personal involvement of Bill Gates. So, flying over Seattle in a Cessna, I thought I'd snap a photo or two. I asked the pilot, "Can you show me where Bill Gates lives?"

"Aarh, down there somewhere", he said. Phooey. Too hard basket.

So, my friends, you're not going to hear about the biggest computer software guru in the USA, but the smallest. Or one of the smallest. There are lots just like him — one person, working on his own, but producing world class software. Most of these people market their stuff as 'shareware', direct to the end user, where you try before you buy.

Eric Meyer is pretty well known around the traps, mostly for his Video Display Editor, or VDE. You might have heard me mention it before; it's the word processor I've used since the CP/M days, for all my magazine work. Just about every word I've ever written for *Electronics Australia* has been pumped through VDE, for some good valid reasons: it's small, it's fast, it's simple, and it's cheap.

I also have a commercial, Windows-based word processor on this same computer, but it's big and fat and slow and sluggish. I only use it when I must impress somebody with a flashy looking business letter or fax. For serious creating writing, where the actual words are more important than the appearance, VDE wins out every time.

So who is this Eric Meyer? Well, he is 'officially' a Lecturer in Science History at the University of Colorado. He is fortunate to live in the town of Boulder, which has to be one of the greatest spots in the USA — right on the edge of the Rocky Mountains and just far enough from the big city of Denver to enjoy its good points, while missing out on its bad points (such as smog and traffic jams).

Now, computer gurus are traditionally thought of as nerds, but Eric Meyer cer-

Eric Meyer, lecturer in Science History at the University of Colorado in Denver, who is also world famous as the author of shareware word processor VDE.

tainly doesn't qualify. He looks like a normal person. He appears to take regular baths, and I am led to believe he sleeps at night instead of hacking away at a computer. He drives a very snappy Audi car, which he pilots through the streets of Boulder with a true expert's hand. He can even find empty parking places.

Being a centre of academia, Boulder is a very international town, and Eric Meyer's main hobby interest is learning and teaching folk dancing from all over the world. So when my daughter Fiona and I accompanied him to dinner at the aptly named Tom's Tavern, the main topic of conversation was music, not computers.

When people of world renown learn that a journalist is coming to town looking for action, they sometimes find it easiest to make themselves scarce. But not so with Eric Meyer; instead of throwing up the barricades, he initiated a fast and furious barrage of e-mail on the Internet, which eventually resulted in him booking all the accommodation for us. What more could one ask?

At the appointed interview hour, Eric turned up at our motel, dressed for comfort and carrying a small backpack.

When I suggested I'd like to get a photo of him with a notebook computer, I was going to use mine for a prop. But no need; Eric reached into his pack and produced his own little Toshiba Portege sub-notebook. Have notebook, will travel. Definitely one of our sort of people.

So how did a uni lecturer end up as a computer programmer? Well, like so many of us, he got 'sucked in' in the early days, wanting to master producing the software as well as using it. His first computer was one of those funny old Osborne sewing machine style portable computers, running a Z-80 microprocessor and the CP/M operating system.

Eric first encountered computer programming in high school and university, where he learned some rudimentary techniques in Basic and Fortran. But he wanted to go deeper, closer to the microprocessor, so that meant learning Assembler, or machine code language. There weren't many textbooks around in those days, but there were little snippets of Assembler code floating around amongst enthusiasts.

So Eric slowly developed a good library of code fragments, for things like putting characters on the screen, collecting characters from the keyboard, and reading and writing disk files. He needed some kind of project to put all these things to work, and the result was the very first version of VDE.

The 'seed' for VDE was a public domain program called 'Video Display Oriented Editor' or VDO. The Assembler source code was published in a magazine, and it later made the rounds of the computer bulletin boards. When assembled, the code resulted in a complete Z-80 text editor only 4K long. It illustrated techniques such as writing characters directly to the screen instead of using the computer's normal software routines. Bypassing all the extra code in the computer meant a whole screen full of characters could appear in the blink of the eye, and that's the main thrust of VDE to this very day — VIDEO DISPLAY editor.

And, despite the inroads made into programming by higher level languages such as C, the VDE editor remains one of the few modern products still written exclusively in Assembler. The reason, says Meyer, is that an editor is basically a character-oriented device. It collects characters from the keyboard, it puts characters on the screen. The IBM-PC, like the earlier CP/M computers, was designed primarily to handle character-based data. Both contain special hardware character-generator IC's that can take a simple ASCII code and turn it into a perfectly formed letter on the screen. And this type of operation is handled fastest and most efficiently by direct use of machine code.

This brings us to the subject of Windows, where all characters are generated as software graphics images; the computer's hardware character generator is ignored. The advantage is that an infinite number of character fonts can be used, instead of the one style associated with a hardware character generator. So, on the screen, 'what you see is what you get' and the exact same character styles can also be reproduced by the printer. The disadvantage is the enormous software grunt needed to do such a deceptively simple job.

Within this context, when will we see the first Windows version of VDE? Eric says, "Not in the immediate future. They've been trying to kill DOS off for a long time now, and it hasn't happened. If I owned stock in Microsoft, or Compaq maybe, I would think that's wonderful. [Windows is being promoted] because it's very 'business'; every year or two a new processor has to come out that's two or three times faster and people have to upgrade all their computers or they can't run the latest version of Windows or the latest CD-ROM version of their favorite program or whatever it is... It's actually sort of insane. For most of the purposes that I use a computer for, the software of the mid-eighties was probably pretty adequate."

"I think there are interesting new things happening as far as music or sound generally, and possibly video; although I have to admit that computerised video doesn't excite me as much as it seems to excite most people."

So what about the possibility that, as computers develop further into graphics-based systems, the hardware-based character generator is deleted entirely; there's no option other than to go bit-mapped graphics? How will Eric Meyer cope with that?

"Then I'll re-write VDE. Sure. If things get to the point that that entire style of programming is entirely obsolete, then I'll learn a new one. But if it gets to the point where computers are so complicated and so sophisticated that it just really doesn't make any sense any more to be writing your own software in anything remotely like an amateur way...

If really the only intelligent alternative is just to buy commercial software because you would have to write 100's of K's of code even just to write a simple utility... If things ever got to that point, then I might just give up on the programming aspect of it and just become yet another consumer of computer products."

What a sad thought. There must be lots of people like Eric Meyer out there, cutting good tight code that runs circles around the commercial stuff. It would be a real pity if computer manufacturers finally make their products so complicated that the Eric Meyers of this world shove the whole thing into the too hard basket. But I would predict that, as long as there are people who think like Eric Meyer, then simple computers will continue to be made, marketed, and bought by grateful purchasers.

A case in point is Hewlett-Packard's latest palmtop computer, the HP200. It's got no Windows, although some icons are used, and it can run reliably and simply as a traditional MS-DOS based computer.

It uses an 80186 microprocessor and seems to be closer to the 'obsolete' PC-XT technology than anything else. Yet people are flocking to buy the things, and others, including Eric Meyer, are writing good tight software, much of it in Assembler. It looks like there's hope for us troglodytes yet! ❖

The Greencell Battery Regenerator

Dry cell recharging has been a 'hot topic' lately, initiated by the release of the Greencell Regenerator and spurred on by other dry cell charger designs, including one by Peter Phillips and presented in *EA*'s January '95 issue. Peter has since done further research into dry cell recharging, and now he reviews the Greencell charger itself.

The Greencell Regenerator is perhaps one of the most controversial products of recent times. It is claimed to be able to extend the life of alkaline cells by up to 10 times, which in turn reduces chemical waste. On the other hand there's a school of thought which refutes this claim, and suggests that such chargers could be dangerous, as alkaline cells are not designed to be recharged.

Fairly obviously, negative publicity about the charger has come from representatives of the battery manufacturing industry, although it's ironic that Greencell market their own range of alkaline and zinc-carbon batteries. As well, the media has joined in, offering opinions and test results that at best, have left many people rather confused.

So, *is* the product safe? Does it *work*, and if so, how well? We'll answer these questions, but first an overall look at the Greencell Regenerator.

The Regenerator

The Regenerator comes in two models. The smallest is the Mini, which suits AA and AAA cells only. The more elaborate (and expensive) version is the Maxi, which can accommodate AAA, AA, C and D size cells. Both models can charge NiCads as well as alkaline and zinc-carbon cells.

The two models differ in size and construction, but are similar in most other respects. Each model can take up to four cells, and each cell is charged independently. The charge status of each cell is indicated with a three-colour LED: red for unable to be charged, amber for charge in process, or green for charge completed. Both units are powered from a plug-pack, which includes an in-built LED indicator to show if the power is on.

While we have no technical details of the electronics, a few simple tests reveal that the charge current is a biased AC, at a frequency of around 300kHz. The charging process of an alkaline (or zinc-carbon) cell is terminated when the terminal voltage of the cell reaches about 1.6V. (Incidentally, a 'biased AC' in this case means the positive half cycle of the charge current has a higher value than the negative half cycle.)

The Greencell Maxi accepts all popular 1.5V dry cells. Up to four same size cells can be charged at a time and the state of each cell is shown with individual LEDS.

Both units have two selector switches; one that selects the charge current and the other for selecting either alkaline (and zinc-carbon) or NiCad cells. The Maxi has three settings for the current, while the Mini has two.

Each battery compartment has the negative contact fixed to a slider to accommodate the different cell sizes. While this is a neat way to get around the problem of making the one compartment 'universal', the sliding mechanism is a little flimsy, and care is needed to avoid bending the sliding mechanism.

Otherwise the construction is solid and well designed. The Mini measures a compact 120 x 75 x 40mm and the Maxi about 205 x 100 x 65mm (LxWxH). Each unit has a transparent lid and the case is made of green plastic. The units are made in China, under licence to the English company Innovations International, a member of the Ringgrip group of companies. The chargers are distributed in Australia and New Zealand by Ringgrip.

A look inside reveals very little. The IC numbers are blanked out, but it's obvious that op-amps are included in the electronics. The assembly is clever and very compact. Virtually everything inside the device is mounted on the printed circuit board, making assembly relatively straightforward.

I'll have more to say about the technical operation of the Regenerator, but now a look at whether it does what it's supposed to.

Dry cell recharging

Before reviewing the Greencell Regenerator, I decided to first examine the overall effectiveness of dry cell recharging. To do this, I used two charging systems: the unit I had designed myself, and of course, the Greencell Regenerator.

My charger uses a biased 50Hz charge current and a 16-hour timer to stop the charge process, compared to the Regenerator's biased 300kHz charge current and voltage sensing system. The results of my tests were published in the March '95 edition of *EA*, with my charger referred to as a 50Hz system and the Regenerator identified as a HF charger.

In summary, I found both charging systems gave similar results and that alkaline cells can most definitely be

recharged, in some cases giving a considerable extension to their life. However, to get the most out of recharging dry cells, some rules need to be followed.

The first is to not let the cell discharge below about 1.1V. The Greencell charger will reject cells with a terminal voltage below 1V, and my tests confirm that discharging a cell to less than 1V makes it virtually useless for recharging purposes

I also found that zinc-carbon cells don't respond very well to recharging, although Greencell claims these cells can be recharged up to three times. However from my tests, this does not mean their *life* is increased three times.

Other findings suggest the discharge current has a bearing on how well a cell will respond to recharging. The time between discharging and recharging is also important, as is the time between recharging and putting the cell back into use.

But the bottom line is: alkaline cells respond well to recharging, allowing users to save money and contribute less chemical waste from discarded dry cells. As well, an alkaline cell has more initial energy and is lighter than a NiCad, which makes them attractive where weight has to be kept as low as possible. But what about NiCads and the Regenerator?

NiCad recharging

While a NiCad cell is usually charged with DC, sometimes a biased AC is better, as it will often get rid of dendrites, which are internal growths that can short-circuit the cell.

Over recent months I have had great success restoring old NiCads by repeating a charge-discharge sequence. In all cases, I've used either the Greencell charger or my own dry cell charger as the charge source. For best effect I've found that the cells should be completely discharged and even left to sit for some time with a short-circuit across the terminals.

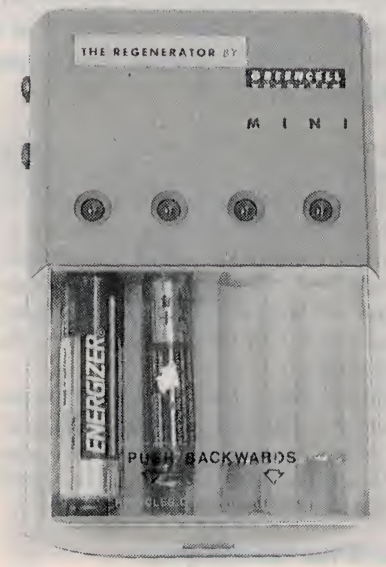
So, as far as my tests show, the Greencell Regenerator does what its maker claims: it effectively charges alkaline and NiCad cells. However, I do have a couple of reservations about the operation of the unit...

Is it safe?

A feature of the Greencell Regenerator is that each cell is treated individually. Each battery compartment is therefore managed by its own circuit, and the time taken to charge a cell depends on the state of the cell. Charging is only possible if the cell voltage is above a certain value, and is terminated when the cell reaches a predetermined voltage.

This system is claimed by the manufacturer to be microprocessor-based and to be completely safe. Another quite important claim is that batteries cannot be overcharged. In other words, the claims suggest the user can simply put a battery into the charger, and leave it.

But when you read the operating manual, you soon realise that the claims made in the advertising literature are a



This is the Greencell Regenerator Mini. It accepts AAA and AA size cells and like the Maxi, is powered with an external plug-pack.

little fuzzy. The fact is that both models of the Regenerator often fail to terminate the charging process. This happens a lot with NiCads, and quite a few times with alkaline cells, particularly AAA and AA sizes.

In fact, I discovered by accident that the unreliable nature of this system is even hazardous. At one stage during my tests I put a number of AAA cells in the Mini Regenerator for recharging. As it turned out I didn't check them until several days later, when I discovered that these cells were still being charged.

But worse still, one of them had burst open — spilling chemicals into the battery compartment, resulting in the usual corrosion and general damage cause by battery chemicals. Fortunately the spillage was contained in the case of the Regenerator, but I had quite a mess to clean up.

I don't know if overcharging an alkaline cell reduces its life, assuming it doesn't split open, but there's no doubt NiCads suffer when overcharged. During my tests, I found the Regenerator Maxi supplied for this review almost never automatically terminated the charging process of a NiCad. I ended up timing each charge sequence with a stop watch, to prevent overcharging.

As well, because my deep-cycling process to rejuvenate the NiCads required them to be discharged to zero volts, I found I had to charge them in another charger until the terminal voltage reached a certain level. Only then would the Regenerator accept them for charging.

In other words, the sophistication of the sensing system is, as far as I'm concerned, the *worst* feature of the Regenerator, not its best as claimed by the maker. Although less sophisticated, a timer like that in my own dry cell charger seems to be far more reliable.

Summary

Apart from the reservations I've just described, both models of the Regenerator are easy to use, effective and versatile. However, they should not be used unattended. You'll be amazed at how much more life you can get from an alkaline cell by recharging it, and I thoroughly recommend doing this. It's a 'green' thing to do, and you save money!.

By the way, although not yet readily available in Australia, at least two manufacturers are now making rechargeable alkaline cells. It shouldn't be long before these are available locally.

The Regenerators for this review were supplied by Dick Smith Electronics. The Mini version has the DSE catalog number M-9509 and retails for $59.95. The Maxi (M-9511) retails for $89.95. ❖

FORUM

Conducted by Jim Rowe

Qualifications for service technicians: the topic that simply will not die...

There are some Forum discussion topics that just won't go away, aren't there? They seem to take on a life of their own, with even one published letter having the ability to prompt another group of readers into writing their own responses. Still, I guess that must mean the topic concerned is of genuine interest to a lot of people, mustn't it?

The thorny subject of qualifications for service technicians is very definitely in this category, and ever since it cropped up again about the middle of last year, I've been getting a steady stream of letters and faxes. Even though I tried to put it aside for a while, after presenting some more letters in the February column, they've kept on coming. So this month I've decided bow to the inevitable, and present a couple more of these later contributions to the 'subject that will not die'...

Before I do, though, I've had an interesting response to the letter we published in the January column, from Mr Jeff Colby of Grovedale in Victoria. You may remember that Mr Colby wrote of his frustration and disappointment in trying to get a job in the electronics industry, despite having worked through a couple of TAFE courses to get suitable qualifications. He seemed to be caught in a vicious circle, where he was unable to get a job because he lacked the magical 'five years experience'.

His letter was very sobering, and one of the responses it produced was a letter from a reader in New Zealand — Mr R. Williams, of Pukekohe. I think you'll find Mr Williams' comments as interesting as I did, because it shows how similar the situations are in both countries. It also touches on the specific difficulties being faced by the servicing industry, as you'll see:

Your FORUM in the January 1995 issue regarding employment in the electronics industry was very interesting.

We have similar problems in New Zealand, with imported electronic products reducing employment potential, probably more so than in Australia.

I hope you will print this letter to inform our Australian friends of the serious danger caused by too many imported goods.

Starting about 1984, radical economic changes were put in place by a handful of Labour politicians. These changes opened the New Zealand economy to overseas investment, allowed virtually unrestricted imports and said the state would no longer provide employment. Employment would be provided by the market place.

The problem is the market place is not there for the benefit of society. The market place is driven by profit. It was quickly found more profit could be made by importing cheap overseas goods.

Need no holidays...

Imported products do not ask for more wages, they do not need holidays or water or power or toilets and never complain. Besides that, once people have a taste of imported goods they often turn up their nose at a local product which can be more expensive and have fewer features. Second hand, near-new imported cars are a case in point. Better, safer products with more features, at an affordable price.

Where is the problem? If better cheaper products are available from overseas we should import them, and in return export the goods and services we can offer to the rest of the world.

The problem is, imported goods reduce employment.

There are a number of companies trying very hard to build up overseas markets, produce quality items and after extensive negotiation export goods overseas. To make export goods as competitive as possible, companies large and small have realised one of their major costs is staff, therefore the answer is simple: reduce the number of staff.

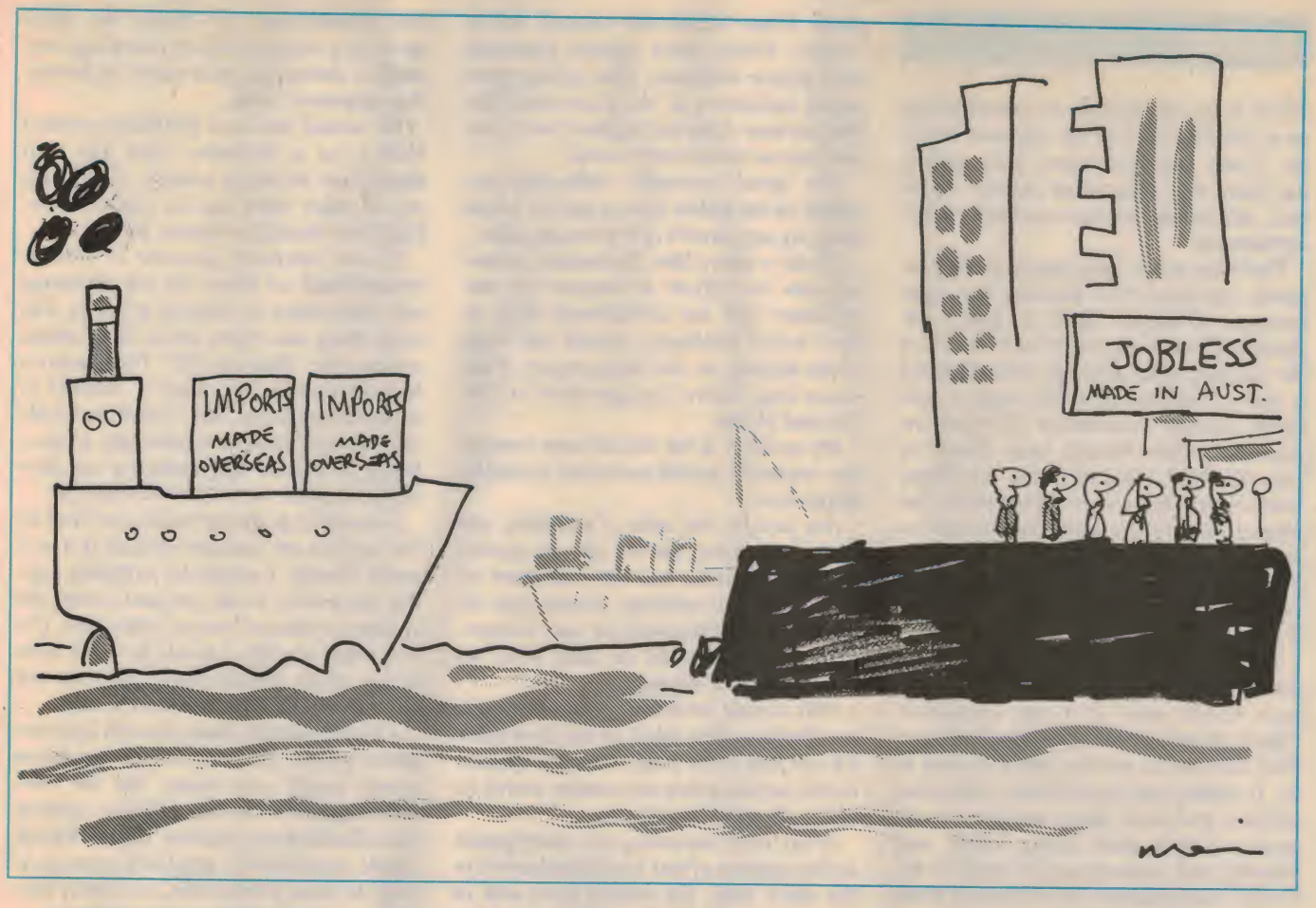
Employment is reduced twice. It is reduced once when we reduce staff to make competitively priced exports, and once again when we sack local production staff and use imported goods.

One would think that local production factories would be mothballed in case they are needed, but this does not happen. Once imports have gained a foothold, more and more local production is shut down until finally there is no local production. With production facilities dismantled, we become locked into imported goods.

I have been in the electronics industry since 1959, working for well known firms and the last 12 years servicing television and video tape recorders. I was apprenticed for five years and hold advanced trade (electronics). Like many others I have spent hours building up circuits of all description because I needed a particular device, or I was interested in a circuit I found in a magazine, or because somebody needed a special item which was not readily available. Building circuits or reading what others had done gave me tremendous enjoyment and pleasure, and I learned a lot from it.

Most of this activity has dropped away now, because almost all domestic electronic goods are imported. Intercoms, stereo, amplifiers for bands, disco equipment and every type of electronic products are all imported and available at very reasonable prices. There is no longer any need to understand what goes on at circuit level, and there is little incentive to build a standard item or specials when there is an imported item which will do the job perfectly. The result is that young people are not so interested in detailed knowledge about electronics, or building circuits or taking on electronics as a trade.

Many changes took place during the last 12 years while I was servicing television sets. In the first few years most



sets were of New Zealand manufacture, with good support from the local manufacturers for assistance with fault diagnosis and plenty of spare parts. One became competent at diagnosing faults and speedy repair at reasonable prices, which customers appreciated.

The situation started changing about eight years ago, when local manufacture of television stopped and all sets were imported. We would just become familiar with one complicated imported chassis, when it would be replaced by a completely different one for the next year's models.

In addition to new chassis from regular importers, we were faced with numerous strange chassis as importers found new TV manufacturers in many other countries. Importers could no longer provide the same level of technical support and did not carry much in the way of spare parts in their warehouse. Many importers were taken over or went out of business, leaving problems for technicians trying to locate spare parts...

Electronics technicians today are faced with very complex circuitry in television, VCRs, car audio, general audio, camcorders, computers, PLC's and many other consumer electronics. One would think technicians would be in demand and well paid to look after this mountain of complex imported product, but this is not the case; technicians are not in demand. Most technicians are paid less than the average wage. In addition, technicians working in the trade have to obtain a yearly practising licence, costing about $100 every year.

Many made redundant

Many technicians have been made redundant, or have just got sick of trying to repair ever-changing televisions and other products for less than the average wage, and have left the trade for other work or early retirement. Those who stayed have no one to pass their years of experience on to, because there are very few young people taking their place. In 1984, 10 years ago, the number of young people entering the electronics industry by way of apprenticeship numbered 3092. Last year there were 18.

Similar problems have occurred in other trades. Local garages no longer do much in the way of engine overhaul or rebuild. Most people if their car engine needs to be repaired, buy an imported engine from an importer and drop it in themselves. This takes a lot of work away from mechanics. In addition, most modern imported second-hand cars are computer controlled and the smaller garages never get sufficient experience to handle modern engine management computer diagnosis, much less carry out repairs.

The low numbers of apprentices entering trades are perhaps due to a lack of interest by young people, but the major stumbling block is lack of desire by companies to increase costs, by taking on inexperienced staff. When companies want staff, they want fully trained staff - who have been trained elsewhere.

Hardly anybody thinks of local production now. Most people are looking through overseas catalogues, searching for a range of crockery, or sheets and towels, or auto transmissions to import and sell. If you can import something which people want or need, you can become very wealthy. Anybody can import almost anything at all. There are no import licences or quotas to worry about. Fax an order, send your LC and bingo, hundreds of toasters arrive.

It seems incredible to me that a small number of importers can import whatever they like and have such a dramatic affect on so many other peoples' lives.

There is no discussion or consultation, as to whether it is in the national interest. Some imported items have tariffs, but these are reduced at regular intervals according to international trade agreements.

There are some good points to the economic upheaval New Zealand has gone through. Overseas debt is being addressed. People are much more aware of the realities of modern life. New Zealand is now considered a stable country, well worth foreign investment. (Foreign investment means buying large lumps of New Zealand industry, land, buildings, retail chains, houses, etc., from under our noses.) The new economy has brought us into an era of much more dynamic action. Because we import so much we have had to become more inventive and purposeful in generating exports.

There are some other points as well. Recent statistics indicate 237,000 citizens would work if it was available. Crime is our fastest growing industry. New Zealand is not the place it used to be. It seems cold hearted and somewhat callous, and most things revolve around money rather than being warm and friendly and outgoing as we used to be. Doors and windows are locked at night and often during the day.

More people have weapons handy in case of intruders. Social organisations like the Salvation Army and Church groups, challenging government on social issues are making no impression. Deep down, we probably still are warm and friendly.

Our leaders say the economy is very strong. They say nothing about the very heavy social cost of these economic changes. Money is the measuring stick. As long as the top third of the country is making money, the country is doing well.

New Zealand is running like an amplifier with far too much feedback. On the surface the performance of our economy is much improved, but there are phase shifts and destructive oscillations cropping up everywhere. A large percentage of qualified tradespersons in all trades have been forced to look for other employment, or have become unemployed.

The latest television news reports some health resources being withheld from elderly patients in Auckland, the largest centre of population. University and tertiary training fees have become so expensive, students have to take loans to cover the cost. These loans run up to 20 or 30 thousand dollars for some degrees. Crime rates are soaring out of control. Police have started rationing their scarce resources. One of the worst social indicators is the distressing fact that we now have the highest youth suicide rate in the western world.

The 'good' economic indicators presented to the public do not tell the whole story, by any stretch of the imagination.

I believe many New Zealanders, knowing now the effects of imports on employment and the detrimental costs to their social wellbeing, would sink most of the imports in the deepest part of the ocean long before they got close to New Zealand shores.

My opinion is we should stop importing consumer goods and make a smaller range here.

Not just for the sake of upsetting our trading partners, but we should explain and communicate and use maximum effort to get the message across that we must have employment for our citizens. If that message falls on deaf ears, we should proceed anyway.

Why should we bother going to all this trouble for a few jobs? In the first place it's not just a few jobs; it's a lot of jobs. In the second place any nation worth its salt looks after its citizens.

In my view importing too many goods at the expense of our local production in the short term, the middle term and in the long term is highly detrimental. I believe the destructive social effects we are experiencing will continue and worsen. If we continue down this path, what we are really saying is that a large number of New Zealanders are not wanted. They cost money to feed and look after, and we don't want the bother of providing employment for them.

`Just a nuisance'

We do want all the good parts of New Zealand like the clean environment, and the fresh water and the plush imported cars, but not all the people we have thrown out of work. They are just a nuisance. We might just as well take 10 or 20 percent of the population out the back and shoot them.

I could perhaps understand our attitude if there was an overwhelming good reason or purpose, but there is not. Some bright sparks have decided we as a nation will no longer worry about local production; we will buy goods from overseas. Our lack of concern for our fellow citizens out of work does us no credit. We should back off consumer imports and recommence local production.

We can get better vacuum cleaners from overseas. We can get better toasters and stereos and car audio. We could turn out a respectable television set, certainly a thousand times easier to service than imported ones.

We would run into problems making VCR's, so a complex item like that should not be made locally. Computers on the other hand can be easily assembled from readily available parts.

If our vacuum cleaner is not as streamlined or fancy as an imported one, who cares, as long as it works. The main thing are those three little words on the side: 'Made in NZ'. That means a New Zealander has built it. Instead of being unemployed they would be working, taking home a regular pay packet, living a regular life, bringing up their children under normal circumstances.

I would be perfectly willing to wind up the cord on my vacuum cleaner if it was made locally. I would be perfectly willing to go over to the set and adjust the volume or channel on my television, if it was made locally. I would be more than happy to fit locally-made tyres on my car, even if they cost me more money.

I would happily make do with less material goods, because locally produced goods would cost more; but the consumer goods I do buy will be creating New Zealand pay packets. Even with our small population, applying ourselves fully to local production, we could turn out some very satisfactory equipment.

Stopping consumer imports and substituting with local production is the only way to generate large chunks of employment. Consumer imports should be stopped before the passage of time makes the situation irreversible.

Hopefully Australia has no plans to dismantle local production.

Hmmm... That made thought-provoking reading, didn't it? Thanks for your comments, Mr Williams. Like those of Jeff Colby they were clearly reflecting a lot of conviction, too.

I guess what struck me, while reading your letter, was the many similarities between the Australian and New Zealand industries. You may be 'ahead' of us in some ways, and 'behind' us in others, but there seem to be lots of areas where you could just as easily have been describing things over here.

It all makes sobering reading, doesn't it? You can't help but wonder about the economic reasoning behind some of these decisions to remove tariff barriers and 'make our industries competitive on the world stage'. If it throws lots of people out of work, causes many skills to be lost and removes a lot of the local control over the economy, it seems a

very strange way to 'improve' things, doesn't it?

Perhaps it's another example of the difficulty we ordinary mortals find in understanding the intricacies of economics. Of course it's always possible that the economists and politicians don't really know what they're doing, either...

I found Mr Williams' comments about the impact of these changes on the servicing industry especially interesting, didn't you? Perhaps it helps explain why service tech's are less prepared to share their knowledge with the rest of us than they used to be, and also rather less tolerant of 'do-it-yourselfers'.

And now that our attention has been turned back to service technicians, let's look at those new contributions to the subject of formal qualifications.

Value of experience

The first I'd like to present came in early February as a fax from Mr Ingmar Meins, VK2KEQ, who manages a computer servicing and support firm in rural NSW. Here's what he has to say:

I have just read, with a good deal of interest, this month's articles in Forum.

My personal experience regarding the requirement for formal technical qualifications tends to go along with those of a number of writers — i.e., who needs them! (Well almost...)

My late father (a refrigeration and process control engineer) brought our family to Australia in mid-1971, in response to an advertisement in a German newspaper. He was qualified as a refrigeration mechanic, diesel mechanic and fitter and turner. Essentially none of these qualifications meant much in Australia.

His genuine interest in all things technical was what really made him good at his work. He worked as a refrigeration mechanic until about 1973-74, when he began with a local agricultural engineering company to start up a winery refrigeration division.

His work involved the design of various types of winery refrigeration and specialist processing equipment. Much of his early design work went into this company's current successes.

He moved to the Northern Territory a few years before he passed away (in 1991) to work as Supervising Mechanical Engineer with the Dept of Works, Alice Springs. There he played a major role in the design and construction of the Arid Zone Research Institute's rock pile/solar greenhouses, and his local Department Head received a letter from the head of the Dept of Works stating that there was no person within the Dept with his knowledge of Thermodynamics and Process control, congratulating him on an excellent job.

All of this from a humble fridge mechanic, who would have had little chance of admission into any of our Engineering Associations, because of a lack of qualifications.

I operate a small computer support/service company in country NSW. My only qualifications are those of a Telecom (Broadcasting) Technician. I sat for the open technicians exams twice before passing them and qualifying. My existing knowledge of electronics was just topped up with the required Broadcasting knowledge using self study, before sitting for the exams.

Academically I'm a bit of a failure. I was expelled (it's all your fault!) almost at the end of Year 8, for not turning up at school often enough. I used to sneak off up the hill behind our house with a few EA's under my arm, read them from cover to cover and then come home again at the end of the school day!

I have been a keen EA reader since about 1972, when I was eight years old.

In spite of my lack of formal training I don't think that I have ever been unemployed for more than a month since leav-

ing school — or should that be school leaving me?

According to the local competition (for whom I was service manager for a number of years after leaving Telecom), they considered and advertised me as 'one of the best this side of the mountains'. The other local competitor poached me from the first on this basis as well...

That from a school dropout with no qualifications, but a very keen hobby interest from an early age. (I used to dream of owning an EDUC-8. I learnt to program on an IBM-5100 at about the same time I received my Novice radio licence, in the 6th grade).

The advice that I give to young people wanting to join the computer service industry these days is, sure get some qualifications — but also play, prod, poke and get your hands dirty (as one writer put it) as much as possible. It's the real deep down hobby interest that will make the difference in the long term, not the number of pieces of paper nor whether or not you wear a suit that determines your abilities.

Well, that was my two cents' worth. Keep up the good work, Jim and your team.

Thanks for those comments, Mr Meins, and both your father's story and your own provide excellent testimony to the value of genuine hobby interest and 'hands on' experience. You don't need to convince *me*, though — I've been aware of this for many years, and tend to 'sound off' about it at the drop of a hat.

The real question, though, is how we go about convincing more young people to think this way. Perhaps it's by relating stories like yours to them as often as possible, and also by showing them how much enjoyment can be gained from hobby activity — quite apart from its enhancement of their chances for employment.

'Multiplier' effect

Anyway, moving on again, our second further contribution to the topic of qualifications comes from Mr Angus Witherby, of Invergowrie in NSW. Mr Witherby's faxed letter is also interesting, because he not only stresses the importance of combining *both* formal training and practical experience, but draws attention to the way the two boost each other, in a kind of 'multiplier' effect:

I know the servicing qualifications debate has been hammering away for a while, but it seems to me that there is one point that doesn't seem to have emerged. Isn't the real question how we develop an effective blend of theoretical rigour AND practical experience? Practical experience itself can certainly take you a long way; so can a formal education in theory. But to really get on top of the servicing game, you need both.

As we have seen time and time again in the Serviceman column, it is in the effective blending of theory and practice that we see the true creativity and imagination that servicing as a career can offer. In this respect I see servicing in the same light as any other problem-solving profession.

I am currently an academic teaching town planning, after working as a qualified local government planner and a consultant for about 10 years. Time and time again I have seen people come to the industry straight out of school and, through workplace experience alone, gain an acceptable level of competency.

When they commence formal studies, however, an interesting thing happens. Once they have sufficient practical experience to begin to apply their theory in the real world, their competency increases in leaps and bounds — often over a quite short time period.

From my own point of view as a planner, I found that my practical experience was outrunning my theoretical training, and this was one of the reasons I changed jobs. I certainly get plenty of the theory now!

The process also works in reverse — but not, I find, quite so well. Learning theory without being able to put it immediately into practice reduces its relevance.

In case you're wondering whether I actually know anything about servicing, I should state that my present job is career number three. I worked as an appliance repair technician for a well-known appliance manufacturer for a while after leaving school and, from a hobbyist background (no piece of paper, I regret to say), found myself well able to maintain shop average throughput rates and below average return rates.

I also supplemented my income at university doing repairs — to equipment that was not economical for the mainstream repairers to handle. Certainly were I still actively involved in servicing (apart from my own equipment) I would be wanting formal education in theory with the associated bit of paper.

Thanks for your comments, Mr Witherby. You're quite right, of course, that what's really needed in some many areas is the right combination of both theory *and* practical experience. One without the other tends to be quite restrictive, but together they really allow you to move ahead with confidence and competence - because each kind of knowledge, skill and understanding 'feeds' the other.

I guess the hard part nowadays, for many newcomers, is to get the practical experience component. Often it's hard for them to break that 'vicious circle' that Jeff Colby and R. Williams have drawn attention to, where firms don't want to put people on to *get* experience - they want them only *after* they've got the experience, elsewhere.

That's where hobby activity can help, though, as Ingmar Meins and I have been suggesting (along with quite a few others, of course).

I hope you'll join me here in the *EA* Forum next month. ❖

NEW KITS FOR EA PROJECTS

FROM JAYCAR ELECTRONICS:

Minispot II AM/FM Alignment Source (April 1995): The Jaycar kit is complete as described, with case, PCB, parts and silk-screened front panel. Catalog number KA-1769, it is priced at $23.95.

Digital Trigger Adaptor for Scopes (April 1995): The Jaycar kit is again complete as described, with case, PCB, parts and silk-screened front panel. Catalog number KA-1772, it is priced at $55.00.

Surround Sound Decoder (May 1995): The Jaycar kit is complete as described, with PCB, case, aluminium plate, punched and silk-screened front panel, and all parts with 1% resistors and MKT capacitors. Catalog number KA-1773, it is priced at $59.50.

FROM DICK SMITH ELECTRONICS:

Playmaster 300W Subwoofer Amplifier (April/May 1995): The DSE kit is complete with all components, original heatsink, pre-punched and silk-screened panels. Catalog number K-5580, it is priced at $349.00 and comes with a bonus.

Smart Door Minder (May 1995): The DSE kit has case, front panel label and all specified components except the torch reflector. Catalog number K-3123, it is priced at $26.95.

Surround Sound Decoder (May 1995): The DSE kit has case, transformer and hardware, pre-punched and silk screened front panel, punched rear panel and all parts. Catalog number K-5406, it is priced at $89.95.

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THE SERVICEMAN

The problems caused by uninformed pot twiddling!

One of our stories this month is a bit esoteric, coming from a fairly specialised area of the communications industry, but it demonstrates very well the dangers of adjusting trim pots when you don't really know what you're doing. There's also the story of repairing a VCR which had been severely 'brain injured', and even a 'ghost story' set in a centuries-old English pub...

One of the first things taught to an apprentice electronics technician is that he must never, ever, twiddle a pre-set pot. Whether it's in audio, radio, TV, industrial or commercial equipment, it can be assumed that the pre-set (aka trimpot) was once correctly adjusted and if it seems to need alteration, there must be a fault somewhere in the circuit. The fault should be identified and corrected first, before any pot twiddling is undertaken.

That discourse was prompted by a story from this month's first contributor, Alan Leitch of Beverley Hills in NSW. Alan is a frequent contributor of stories from the security and telephone industries and this time his tale comes from the latter source.

I'll let Alan tell his story first, then see what comments need to be made afterwards. He calls his tale:

The Pot Twiddler

A 24-channel 50 baud telegraph system had been installed and commissioned. This was an FSK (frequency shift keying) system, with 24 audio subcarriers in the 3kHz bandwidth of a telephone channel. The channel spacing was 120Hz and the FSK deviation +/-30Hz, with the first channel at 420Hz centre frequency.

The commissioning had been completed without a hitch, but when the system was connected to real traffic the telegraph engineer complained of high Bit Error Rates on channel 20, in one direction only. What's more, the BER increased as the traffic on the other channels increased.

The bias distortion (mark/space ratio) was checked and found to be within +/-1.0%, but if a character generator was connected to the channel the BER was unacceptable. The BER was monitored over a number of hours and the error rate varied with the traffic on the system, confirming the telegraph engineer's findings.

At the first available opportunity the system was taken off traffic and the bearer channel levels were checked. The end to end levels were within 1dB of specification, but the setting of the receive gain potentiometer was about 3dB lower than those on adjacent bearer channels. This indicated that there was possibly a high level point somewhere on that bearer channel.

Without changing the setting of this pot, an audio wave analyser was connected to the output of the channel 20 receive filter and the transmit signal of this channel was disabled at the distant end. This confirmed our suspicions as there were some intermodulation products in the passband of the filter, at a level of -43dBm.

The bearer channel plan was examined and a likely point identified, where two carrier systems were connected back to back. The technician at this site was asked to check the levels of the bearer. To access this point he had to remove a 6dB plug-in attenuator before he could measure the receive level. This level checked OK, but when he injected a -15dBm tone into the transmit path, we measured a signal which was 3dB low.

We adjusted our receive gain control to compensate, but when the technician removed his test gear and replaced the plug-in attenuator, our receive level was 3dB high. Substitution of the attenuator corrected this problem and examination of the faulty unit revealed a dry solder joint in the shunt arm.

The cause of the high BER was intermodulation products, produced by a 3dB overload of the ring-bridge modulator in the second carrier system, by the combined power of 24 audio tones of -23dBm.

The technician who had commissioned the telegraph system was reprimanded for the cardinal sin of pot twiddling. In

his eagerness to proceed with the commissioning tests, he had reduced the receive level of the bearer channel without first investigating the reason for the high receive level.

Well, that was all very technical and everything, but I think it confirms my contention that pot twiddling is definitely a No-No. On the other hand, pot adjusting is quite OK when you know what you are doing and *why* you are doing it.

Trim pots are provided in electronic circuits for just that reason — to TRIM the circuit and compensate for minor variations or changes in component values. If a trim value appears to need a major change, and in Alan's story 3dB is major — a 50% change in value — then there is something very much out of place in the circuit.

Fortunately, or perhaps unfortunately, in domestic service we do not have to be quite so precise with our measurements as did Alan and his fellow telegraph engineers. However, it still behoves us to leave those trim pots alone unless we have a very good and clear reason to touch them...

Thanks for this story, Alan. There are still a few more of your stories on file, so we will be hearing from you again soon.

Ghost control?

The next item is not really a servicing story, but since it is about a television set and it's not too long, I feel I should share it with you.

The story comes from Mr William Linton, of Zilmere in Queensland, and relates to an overseas trip he took recently. Here's what he has to say...

While in the United Kingdom, I took a short motoring trip around the counties close to London, visiting Roman ruins, old country churches and other antiquities.

On the Sunday I found myself in a Suffolk village called Long Melford and decided to stay the night there. I chose a hotel called 'The Crown', which could be described as a typical English country inn, about 500 years old with blackened oak beams and creaking floor boards.

I decided to retire early that evening, since I was dog tired after driving for many hours on roads clogged with bank holiday weekend traffic. The first inkling I got that there was something not quite right with the place was when I opened the door of my room and the key became stuck in the lock. Try as I might I could not release it, yet next morning the key came out quite easily. Strange...

Shortly after midnight, while I was in a deep sleep, the TV came on of its own accord and woke me. I grabbed the remote control handset from the bedside table and pressed what I thought was the standby button. But instead, it was the volume up button and the sound was deafening — the more so since it was after midnight in a spooky old country inn.

I fumbled for the light switch, then found and hit the mute and standby buttons. Then, to be on the safe side, I pulled the TV's plug from the wall socket. Ghosts might be able to turn on TV sets, but I'm sure they can't replace power plugs!

Next morning, at breakfast, I told the landlady about my experience of the previous night, and jokingly asked if the hotel had a resident ghost.

She laughed at my suggestion and ventured the opinion that a previous guest had probably set it to come on at that time. However, when I examined the set later I found that it had no self-timer — so a ghost was the only 'practical' explanation.

There are hundreds of old inns like the Crown throughout Britain, many of which are reputed to have their own resident ghosts. However for business reasons, most landlords try to hush up such things. But self-starting TVs? I wonder!

Well, our contributors have told of a lot of different things over the years, but this is the first time we have ever presented a 'Ghost Story'. However, since I am not superstitious, I would have preferred it if Mr Linton had presented us with a rational explanation. Something like an on/off switch that doesn't quite toggle into the off position.

I once had a set like that. Unless the user gave the switch a hard thump, it would turn the set off alright but then hang in a 'half off/half on' position. Later, anything from 10 minutes to 10 hours later, it would drop back into the 'on' position quite spontaneously. If this had happened to me late at night, in someplace other than my workshop, I think I might have suddenly become very superstitious.

Thanks for that little story, William. It's anecdotes like yours that relieve the tedium of never ending repair stories.

Brain injured VCR

Now, we go back to a more conventional Serviceman story. This time it's a VCR that was playing up. The author of this tale is Graham Smith, of Lindfield in NSW.

Actually, to say that the machine was 'playing up' is a bit of an understatement. In truth, it had given up playing up, and was as near to a write-off as any I've ever heard about. However, since Graham is a self confessed non-professional serviceman, the time he spent on this VCR is of no consequence.

In the process of finding and repairing all the many faults in this machine, he learned a great deal about the operations and functions of a microprocessor controlled VCR. I think you will learn a lot, too, as Graham tells of his battles with this particular VCR:

A common ingredient in many stories presented in The Serviceman is perseverance. Although an individual job may have outdistanced profitability, customer respect should generate future jobs. But what drives a non-professional? In my case, repayment for services rendered, an opportunity to learn and, I'm told, a masochistic tendency.

Though I started university in electronic engineering, computing science overtook that subject in prominence. I keep my iron warm with the occasional repair of office computer equipment and domestic jobs, but I'd never had the call to service a VCR until I was directed to a dusty and partially disassembled Akai VS2 chassis in the corner of a smoke filled living room. Since I own an operational VS2, there was evidently potential for an educational resurrection. So I invested in a manual.

The initial symptoms were indeterminate servo state at power on, and front panel buttons which were ineffective. Sometimes the drum motor would start, sometimes the takeup motor. The initial hope was that the old (memory) battery may have affected reset generation, but this was quickly dismissed.

This chassis has two processors, one on the front 'Operation' board and one on the 'Syscon' board. Swapping each of

these boards in turn with the equivalent boards from my good machine supported the theory that the Syscon board processor was not being reset.

The circuit diagram showed no components in the reset line from the Operation board, although the component layout showed a wire link. The board itself was marked D10 where the wire link was expected and included a strange yellow-coated thing looking nothing like the link in the other chassis. It was removed and measured in megohms, both ways. Since there was no apparent reason for a diode or anything more resistive than copper at that point, a real wire link was substituted.

Gazing over the board, it was obvious that it had been subjected to serious component removal, including the 42-pin processor. Someone had been here before me. I qondered if it was possible that such a simple fault had been overlooked?*

Any feeling of achievement was soon quashed however; there was still a long road ahead...

Next I found the Operation board only partially functional, and soon learned that the battery had issued forth electrolyte which had etched away some copper tracks, and damaged contacts in the B and C buttons. The board was cleaned, missing tracks were re-established using hookup wire, and the critical switch C rotated with the lesser used Memory switch.

(My good machine was showing early signs of copper etching from battery leakage. Both batteries were to be later replaced with gold caps, since the NiCads had been well and truly disgraced).

The Operation board also had suffered from prior brain surgery. Suspicious enquiry regarding the machine's history drew little information, only that a tape had jammed.

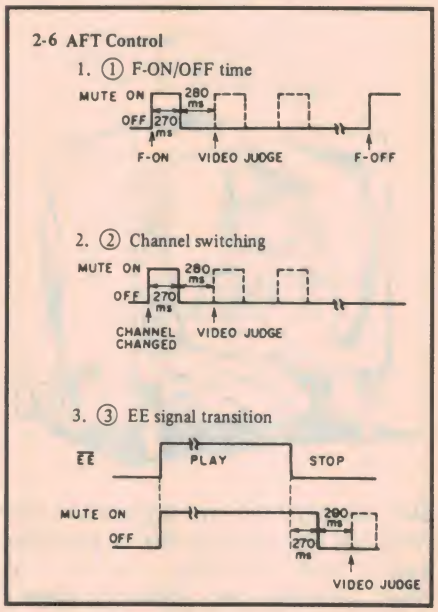
It was a huge relief to find that with an operational front panel, it was possible to tune stations. So the RF front end was intact. That part was satisfying, but there were no on-screen messages appearing on the picture.

After spending considerable time learning the subtleties of the character generator on the Operation board, and how it mixes with normal video on the Video board, a not-so-subtle fracture in the latter board was discovered. After patching conductors in the vicinity of the fracture, I was rewarded with a full on-screen display.

Evidently the sync pulses required by the character generator were not previously available. But now, with the superimpose function working, it was no longer possible to tune a station!

So it was 'Time Out' to study operation of the video judge mechanism, which all seemed fine; indeed it had been working before. Eventually a nervous adjustment of VR13 (AFC), being adjacent to the board fracture, restored 'judge' signal processing. This meant that the Operation microprocessor could now tell when it had parked the tuner frequency on a station, and so release the mute.

The next test revealed a very poor playback picture, even after scrupulous cleaning of the tape path and drum. I suspected misplaced or mistimed control pulses, which set me to reading up on control head adjustment.



These AFT control timing diagrams are the only reference to 'Video Judge' in the whole Akai VS-2 manual. Elsewhere in the AFT section the process is referred to as 'Video Testing'. Japanese English does not make technical descriptions easy to understand, does it?

While checking path guides, a tape was mangled when in quick reverse play — not because of guide heights, but rather because a pin in the tape path (just east of the pinch roller) was leaning over at about 60 degrees! It was restored to an upright position using brute force.

A reasonable picture was eventually achieved by shortening the distance between the drum and control head. But although speech playback was acceptable, music playback sounded very wobbly. Despite all my efforts so far, the problem was real and could not be ignored.

Now turning my attention to the Servo board, the capstan motor speed test point displayed a gentle yo-yo effect. Observing the capstan motor drive signals on the 'scope showed the presence of a disturbing signal. Apart from the one second oscillation period there was an additional signal with a period of about 20ms, and other clippings.

Attempting to isolate the origin of that 20ms component, the capstan feedback to output drive was broken by removing TR8 and substituting a resistor. Though now running too fast, the worrying signals persisted in the early sections of the capstan motor control, starting at the head feedback Schmidt trigger output.

The signal was not at the input, and barely noticeable on the supply rail. Additional decoupling was of no benefit. The output of the Schmidt trigger feeds the control chip IC11, an AN6341 via an analog switch type MC14066. Test swapping IC11 was futile.

In the 4066 package there are four analog switches. In quick play mode a separate switch selects a divide-by-seven feedback signal into IC11, which incidentally did not evidence the nuisance modulation when actioned. When the solder was sucked off the divide-by-seven switch output, IC11 was still seeing the 20ms nonsense, but when the divide-by-seven switch input was disconnected, normality returned.

The 4066 was replaced, feedback restored and there was no more wow. That 20ms signal was not mains induced as had I presumed, nor was it exactly 20ms. Rather it was nominally 400/7Hz, passing internally between two switches of the 4066 package! Yes indeed, one must not assume anything...

Now by this stage I felt that everything looked fine, apart from the record function. A tape recorded on the subject machine would not track at all well on any other machine. Head switching point adjustments offered no improvement.

Re-reading the information about control head adjustment led to the inescapable conclusion that one video head was not delivering a useful signal. On close inspection it was found to be unseated from its base plate, and just flapping about in the breeze. Indeed it appears that the prior adjustment of the control head merely optimised the two head wipes so that each got a marginal signal on playback, but quite useless for recording. So a replacement head drum fixed everything.

Which, if any, of these faults existed

when the machine was decommissioned? Which, on the other hand, were later inflicted upon it by subsequent man-handling? What was the previous 'iron bearer' looking for?

In committing this monologue to paper, whole schools of red herring have been necessarily left out. One of these schools includes the many dry joints exposed. Only one scrap of silicon had to be replaced. Was that the single original fault?

Hindsight always offers greater clarity, so this episode was a beneficial learning experience. But do you suppose that Mrs Smith agrees?

No, Mr Smith. I know she doesn't! I sometimes envy those other tradesmen, like butchers and greengrocers, whose wives can pitch in and help in the shop. There are precious few Mrs Servicemen who want to help on the counter, let alone help in the workshop.

Now back to your Akai VCR. Your story gives rise to the question "Would you have started if you had known in advance the problems you were going to find?" Your description of the machine as you found it would have warned any full-time serviceman to leave it well alone. Most of us have found a chain of faults like yours, but in every case the machine had been presented in pristine condition.

I long ago learned to refuse any job that showed evidence of attempted home repair. TV's with the back unscrewed, or videos with the cover removed are like a red rag to a bull.

Even if there are no parts missing or plugs fitted to the wrong sockets, it is still likely that the 'intruder' has twiddled every trimpot in sight and a complete realignment is needed before the original fault can be found and repaired — that is, if the alignment *can* be done before the fault is found and repaired. A real Catch-22 situation if ever there was one!

So Graham Smith was particularly game to tackle the VS-2 as he did. Fortunately, he solved all the problems and still had enthusiasm enough to write of his experiences for these pages. Thanks, Graham. I'm sure readers will have learned much from your story.

Incidentally, there was one part of Graham's story that had me completely flumoxed. What on earth was the 'Video Judge Mechanism'? I had never heard of it, and couldn't imagine what it was all about.

I had to read my own copy of the manual right through twice before I came upon the explanation, on page 20, under the heading AFT Control. After describing the action of the AFT and Mute circuits, the description continues *...280ms after the AFT is turned on, video testing is conducted; if judged as 'Not Video' the above procedure is repeated as many times as is necessary.*

So the 'Video Judge Mechanism' simply looks for video during tuning or search operations, and stops the process when a viable channel has been found. I've often heard of a 'circuit judge', but this the first time I've ever heard reference to a 'judge circuit'.

Plenty of hobbyists!

Finally, here's a short item from my own workshop, inspired by the need to tidy the place up before I get too old to tidy the place up — if you know what I mean...

I've seen lots of claims recently that electronics hobbyists can no longer build projects from the contents of their junk boxes. If you are going to build an up-to-date project, say the pundits, you have to have lots of highly specialised parts not likely to be found in a junk box.

I beg to differ, and claim that there are still lots of hobbyists that can make quite useful projects from discrete components of moderate vintage.

As I've mentioned before, I'm going into semi-retirement, and as a consequence, I'm trying to clear out my workshop and other storage spots.

In particular, my 'under-the-house' store has had to be cleaned up and the first result was seven large boxes of old TV panels, valve and transistor radio chassis, tape recorder bits and pieces and lots and lots of unidentifiable PCB's.

I'm only half way through the cleanout, and already I estimate I've had four wagon loads of stuff to go to the tip.

One evening I was bemoaning the need to dump all this once- valuable material, and wishing I could find some young hobbyists or electronic enthusiasts who might get some benefit from it. At this point, my wife suggested that I advertise it in the Flea Market section of the local paper.

It seems that the Monday edition of the paper is very short on classified advertisements, so the management decided to offer free space for community announcements and particularly, for advertising low cost household items.

The idea is that anything being offered for sale for less than $50 can be advertised free in the Monday paper's Flea Market columns. I took advantage of the offer and ran an ad saying 'Free — electronic bits and pieces for hobbyists or enthusiasts...'

The phone began to ring at seven o'clock on Monday morning, and by Tuesday lunchtime, I could have given away 14 boxes of junk.

Most of the callers were mothers, calling on behalf of high school student sons and daughters. But the most unexpected caller was a 35-year-old taxi driver from a nearby country town. It seems that he normally works the night shift, and in the long hours between calls, he studies electronics as a hobby and hopes one day to get his AOCP.

The first seven callers each went off with a box of junk/treasures (depending which side of the box you are standing on!) and my storage area was looking decidedly tidier than it had been. I've still got seven numbers to call when I clear out more junk, so whoever it was that said electronics as a hobby is dead doesn't know what he's talking about.

*A final note about that word 'q(u)ondered'. This is a totally accidental coinage, that I might patent! The word should have been 'wondered', but the result of my tangled fingers is so graphic — combining as it does Questioned and Wondered, and a goodly dash of Quandary — that I decided to leave it in place. It's a perfect description of a state of mind that most servicemen find themselves in almost every day. Most typographical errors don't make sense, but here is one that really does!

That's all for this month. There are still a number of contributor's items on hand, but we can always take more. See you next time. ❖

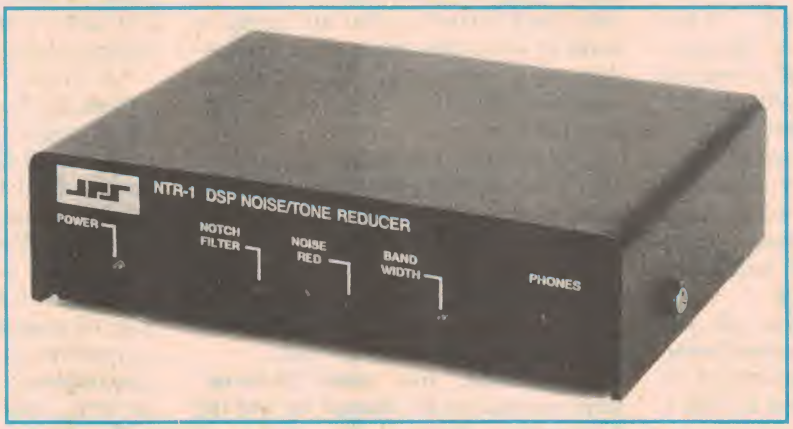
DSP REVISITED: The Next Generation

In the January issue, Tom Moffat reported on his experiences trying out a couple of 'black boxes' which use modern digital signal processing technology to improve shortwave reception. Here he looks at another one of these units, offering simpler operation, and also at an 'intelligent' audio-derived squelch module which can be fitted into existing receivers.

by TOM MOFFAT, VK7TM

A couple of months ago we looked at a pair of digital speech processing units from the American JPS Communications company. These interesting gadgets used computer techniques to 'clean up' a noisy or interference-laden signal from a receiver. The units concerned work at the 'tail end' of the chain, on the recovered audio, so there is no need to modify the receiver in any way.

The units worked very well indeed. My only concern, which was so minor I didn't bother to mention it in the article, was that the units were a little fiddly to operate, and they required some 'smarts' on the part of the operator to get the best out of them.



The NTR-1 noise and toner remover box, which takes audio from your receiver and after processing it, drives an external speaker or pair of headphones.It uses the PEAK system of noise reduction.

Now ZRV Electronics, the Australian importers of the DSP units, have sent me a brand new DSP unit which overcomes the complexity of the earlier units while providing very credible performance. They also supplied a tiny squelch unit based on DSP principles, for fitting inside a receiver. Now we will examine both these products in detail.

Noise & tone remover

The NTR-1 is a 'black box' that sits near the receiver. It connects to the radio's audio via its external speaker or headphone jack, and in turn drives an external speaker or a pair of headphones. It also requires a nominal +12V DC supply. So physically, it is very similar to the two units reviewed previously.

The front panel is simplicity itself — four pushbuttons of the push on, push off variety. One of these is the power switch; when it's off the audio goes straight through from the radio to the external speaker. The next button selects the notch filter. The third button selects noise reduction, and the fourth button selects whether noise reduction should work in a wide or narrow bandwidth. LEDs indicate when these buttons are active.

The notch filter seems to be a little more 'powerful' than on the earlier DSP units. If you tune to a constant carrier and then hit the notch, the carrier isn't just attenuated; it's completely zapped. The notch is so sharp that there is no audible 'hole' in the frequency response. What's left is radio noise with no signal evident at all, just as if the receiver were tuned to a spot with no stations.

Just for fun you can quickly touch the radio's tuning knob to change the frequency of the audio whistle. You will then hear it briefly as a 'peep', until the DSP unit finds it again and squashes it flat. This is quite a startling result.

The noise reducer function in the NTR-1 unit is of the PEAK rather than the NIR (noise-interference reduction) variety. And as I said in the earlier review of the JPS NIR, "This (the PEAK mode) is promoted as kind of an 'also-ran' in the JPS communications literature, but it seems to me to be more important and useful than even the NIR."

I guess JPS might have been thinking along the same lines, because they've come up with a nice, smooth, easy to operate PEAK mode in this new unit, and they've deleted the NIR completely. The NIR does have its uses in digging out absolutely horribly mutilated signals, but for day to day use the PEAK method is preferred, in my opinion.

As described in the earlier article, PEAK is a 'rubber filter' that expands and contracts to fit the incoming signal's bandwidth, and the way it works is almost too good to be true. The only restriction is that there must be enough signal rising out of the noise for PEAK to get its teeth into. And, except for the most ardent die-hards, most people wouldn't try to listen to truly nasty signals, other than to identify them and then abandon them.

So a reasonable signal for the noise reducer to work with might be a single-sideband station producing about S-2 or S-3 on the radio's signal strength meter. There will be the usual background of crackles and pops, normal radio noise. Perhaps this will be a marine or aviation HF channel. The strongest signals will be land-based stations, and the weaker ones will come from planes or boats. A lot of the time there is no activity on the channel, just noise.

Since it's SSB we're using, you would first press the bandwidth button for

NARROW. If you then press the noise reduction switch on the NTR-1, the noise will be reduced (we are full of profound statements today). If the noise is minor it may disappear altogether. Then, when a station comes on the frequency, a human voice suddenly erupts from the speaker as if the person on the other end were connected by wire instead of radio. That station stops, another speaks — and there's another clear voice. It's all very civilised.

The WIDE bandwidth is more appropriate for AM signals, such as produced by the big international broadcast stations. Many of these are plenty strong and there is no need for the noise reducer; in fact there is a disadvantage, since the DSP process appears to cut the higher audio frequencies somewhat. But if you go for one of the weaker stations, the noise reducer certainly smartens things up.

I gave it a pretty good test on one of the numerous religious broadcasters that inhabit the shortwave bands. This one, on the 17MHz band, seemed to be broadcasting from New Orleans, although not beaming at Australia. So its signal was fading between S-2 and S-4 on the meter. There was some noise and monkey-chatter from nearby stations, and some distortion due to the fading.

Clicking in the noise reducer lifted the signal right out of the rubbish, although at the expense of somewhat restricted audio response. The station was having an hour of old-time gospel music, something I've got a soft spot for (it's becoming very trendy, especially on radio shows that feature blues and jazz music).

So, with one finger on the noise reducer button, I settled in to listen to the Good Ol' Boys singin' about Jesus. I listened with the noise reducer on, and I listened with it off. And on, and off. And I eventually left the noise reducer on. Had it not been available I probably would have abandoned the station before long, because all the noise and rubbish gets a bit trying after a while. And THAT is the value of the 'peak' method of noise reduction.

As for data modes — fax and radioteletype — the results of noise reduction *sounded* pretty impressive, producing almost total silence behind all but the weakest signals. But there didn't seem to be a lot of difference where it counts, in the pictures and printouts. This is because any data decoder worth its salt (Listening Post II in this case) is pretty well immune to noise already.

Where the NTR-1 really shines is on Morse code. Using noise reduction and narrow bandwidth and a reasonable-quality signal, the audio goes completely silent between the dots and dashes.

I spent a fair bit of time listening to a couple of Melbourne stations having a local chat on 40 metres. They were a few hundred hertz apart in frequency. First the high one and then the low one would send, very informal and easy-going. The peak filter was able to grab onto each of the two different tones, while maintaining silence when neither were sending. It sounded more like two guys sitting in a room sending to each other with code practice oscillators. Very smooth!

However, should another interfering

Here is the Naval Electronics squelch module (front) with a box of matches to indicate its size.

Morse station appear while the peak mode is in use, the whole system collapses. The DSP unit can't decide which is the correct signal, so it tries to receive them both. If you get wise and try to remove one of them with the notch filter, this is automatic too. So the notch is jumping around trying to zap both signals, while the peak is trying to receive both. What a mess!

I have discovered that you really *must* use fast AGC (described below) when using DSP. Slow AGC lets the incoming audio bounce up and down a bit, and the DSP is not impressed. It's also not really happy with signals that are fading fast, around a syllabic rate. Fading is more common at night, so DSP as a whole seems to work somewhat better during the day.

All in all, the NTR-1's many advantages outweigh its few disadvantages. I would suggest a keen radio listener would find it very useful, especially since for most purposes you can just press a button and then forget it. As well it's somewhat cheaper than the earlier units, at $350 in Australia.

Squelch module

Squelch, for those not yet in the know, is the process of dousing a receiver's audio when no signal is coming through. Without squelch, an operator would have to listen to a cacophony of hissing, cracks, and pops while waiting for something sensible to appear.

This is no problem over the short term, but for somebody whose job is to listen for signals day in and day out, a decent squelch unit would be a welcome device indeed.

In VHF-FM service or AM, there is always a carrier with the desired signal. So a simple and 100% effective squelch circuit can be designed to turn the radio's audio on when a carrier is present, or turn it off when there is no carrier. If you have a VHF/UHF amateur rig, or a scanner, you know how effective carrier squelch can be, and how aggravating the radio would be without it.

Most modern HF receivers and transceivers also have a carrier- operated squelch, but these are never completely foolproof. With an AM signal there is a carrier, so the squelch opens and closes normally. But it also sees as signals such things as static crashes, which are characteristic of the HF frequencies. Thus the squelch opens briefly with every crash and bang on the radio channel.

With single sideband things are even worse, since there is no carrier with the signal. Receivers overcome this by rectifying some of the sideband signal, so the resultant DC voltage is a measure of the signal's strength. This voltage is used for the receiver's automatic gain control (AGC) and for driving the S- Meter.

Since the transmitter operator's voice is varying in strength with every syllable, so does the AGC voltage. To prevent the receiver's gain from bouncing up and down at a syllabic rate, it is usual to apply a diode and capacitor arrangement across the AGC line so the voltage comes up fast but decays very slowly. Most radios give you a choice of

DSP REVISITED: The Next Generation

'fast' or 'slow' AGC, and slow is almost always used for SSB.

The AGC action in most receivers is also 'delayed', meaning that for very weak signals, the receiver gain is allowed to run flat out until signals reach a certain strength. From then on, AGC is applied. The idea is to maximise the sensitivity of the receiver to weak signals.

Now consider the case of a carrier-operated squelch working with the AGC voltage derived from an SSB signal. If fast AGC is selected, the squelch tends to shut down the receiver's audio between words, producing a very choppy effect. But if slow AGC is used, The long decay time means that every static crash is drawn out to a painful length, and listening on an HF-SSB channel with carrier squelch means you either put up with frequent noise bursts, or you desensitise the squelch circuit so much that you miss the weaker signals.

Another problem comes about with squelch based on 'delayed' AGC. Because no AGC voltage is developed by the weakest signals, they will not open the squelch at all and will be completely missed.

These are the problems attacked by the squelch module produced by Naval Electronics of Florida. It's a little circuit board that installs inside your receiver. It's impossible to see what's on it because the whole assembly has been potted in brown gloop, possibly for protection but more likely to shield it from prying eyes which might be looking to 'reverse engineer' it.

All connections to the PCB are brought out to 10 pins on its edge. These are of the usual 0.1" spacing, so you can make a matching connector for the PCB by slicing a 20-pin IC socket in half with a hacksaw. The pins carry power, audio in and out, and three leads to an external trimpot which is preset for the desired squelch sensitivity threshold. You can also install a switch to bypass the unit completely, and this is intended to be the only operator control.

The Naval squelch module totally ignores the receiver's AGC line and works on the audio only, using DSP techniques. What it does is listen to everything that comes in, and it makes an educated guess at what constitutes human voice. In theory, only human voice can open the squelch, and the circuit is impervious to static, heterodynes, and other non-human noises.

Engineers have been working for a long time to achieve this. I remember some of the Codan SSB radios from 15 years ago had 'speech-recognition' squelch circuits that worked after a fashion. But, without microprocessor technology, it was a hard task.

Now it looks like Naval Electronics has just about cracked it. I gave their squelch unit a pretty good run haywired to my Icom R- 71 HF receiver. As usual I tuned to the familiar 8867kHz aviation channel, which is always active with SSB signals from far and wide, with strengths varying from 'rock-crushing' to 'bugger- all'.

To cut a long story short, the thing worked pretty well. During the daylight hours it was just about faultless, letting through the very weakest voice signals while ignoring healthy doses of noise. But as with the other DSP-based devices, it was a little less effective at night because of fading and echo-producing static crashes that tricked it into thinking it was hearing speech.

Still, 90% of the time, the Naval squelch unit provides blessed relief from the continuous radio racket while still allowing the operator to hear any legitimate calls. For somebody such as an air traffic controller who has to listen for hours at a time on channels such as 8867, the DSP squelch unit would be a most attractive proposition.

After using the squelch unit for several days on aviation and marine channels and anything else I could find, I have decided I would try to install the unit permanently into a receiver with a proper fully variable 'squelch control' instead of a hidden trimpot. As with other types of squelch circuit, the optimum threshold setting seems to vary with the time of day and the noise level at the time.

In the case of my Icom receiver, I would probably be prepared to abandon its own AGC-based squelch and use the front-panel squelch knob to control the Naval unit instead.

All in all she's a go-er, although not really cheap. The price for that little PCB is $256 in Australia. But then again, it does the job. And unless someone breaks through that brown gloop and copies it, the Naval unit is possibly the ONLY one that does the job so well.

Thanks to ZRV Electronics for their loan of both the NTR-1 noise remover and the Naval squelch module. Further information on both units is available from ZRV at Unit 10, 29 Peel Street, Eltham 3095; phone (03) 439 3389 or fax (03) 439 2483. ❖

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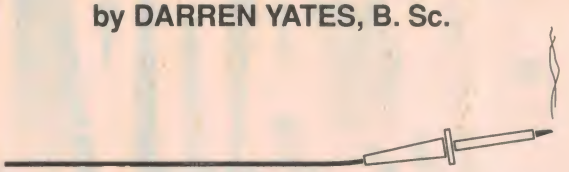
READER INFO NO. 18

Experimenting with Electronics

by DARREN YATES, B. Sc.



The many uses for diodes

Diodes are the most simple of semiconductors, but they are extremely useful little components. This month, we have a number of diode circuits, and although some of which are standard text-book stuff, there are others which you may not have seen before. As you can see, well known circuit designer and author Darren Yates is also taking over the column with this article.

Over the last couple of years, Experimenting with Electronics has become a very popular column, giving readers the chance to learn more about electronics with some simple yet entertaining circuits. The column's popularity is due to the efforts of Peter Murtagh and Peter Phillips, and I'm sure you'll agree they have done a fantastic job in continually coming up with some great ideas. I've enjoyed reading their monthly offerings myself, and I'd like to thank *EA*'s Editor Jim Rowe for giving me the opportunity to continue on their good work.

Since the task of this column is basically to provide you with circuits for experimenting, we've decided to take a different approach for a while. Each month, we'll provide a number of simple circuits based on a particular topic or device. We won't give you a PCB pattern or physical layout — that'll be left for you to do. But we will give you a number of circuits that you may not have seen before and which you can add to your own projects.

So what can you do with a diode?

You'd be hard pressed to find a circuit that didn't use at least one diode. For a component which simply allows current to flow in one direction and not the other, they are one of the most versatile components around. And for around seven cents, you'd be hard pressed to find another one that's cheaper.

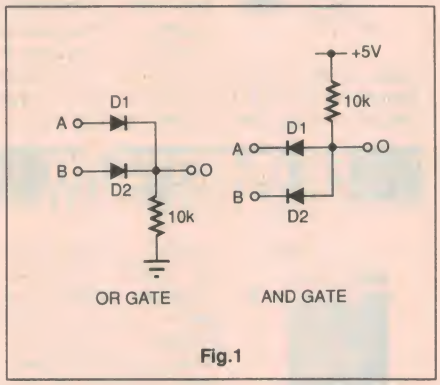


Fig.1

OK. Most people know that they're used as rectifiers in power supplies, to turn AC into DC. We've even included a couple of rectifier circuits here, but we thought we'd start off using diodes in logic circuits.

Diode logic

Quite often, a circuit will require an odd number of logic gates. In the case where you want just one gate, it's a waste to use an IC package with four gates. The easy alternative is to use diode logic.

Back when digital logic was in its infancy and CMOS ICs didn't exist, diodes and transistors were the stock-in-trade of the engineer. To get us started, Fig.1 shows two practical circuits for a diode-based OR and AND gate. Both circuits are only two-input gates, but they are easily expandable by simply adding more diodes.

Where the inputs signals come from a relatively low impedance such as the outputs of IC gates, the circuits work exceptionally well. The only problem which can occur is when you wish to link, say, a diode OR gate and a diode AND gate together, as shown in Fig.2. Notice that the output resistor of the AND gate has been increased to 47kΩ. If we left it at 10KΩ, the output voltage at X would be about 2.5V or so with both inputs of the AND gate low. By increasing the output impedance of the AND gate, you get a much larger change in output voltage at the expense of output impedance.

In very basic terms, the ideal logic gate has infinite input impedance and zero output impedance.

There are some cases where the circuit of Fig.2 is not the best but in most hobby

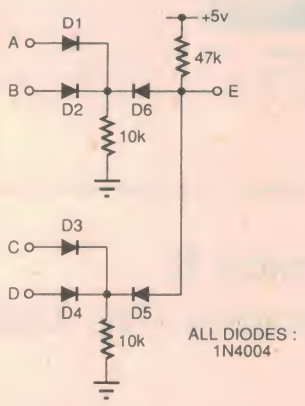


Fig.2

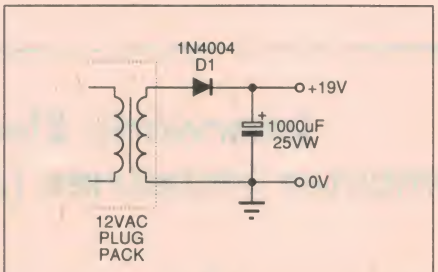


Fig.3

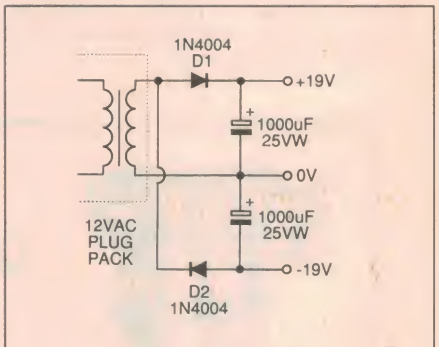


Fig.4

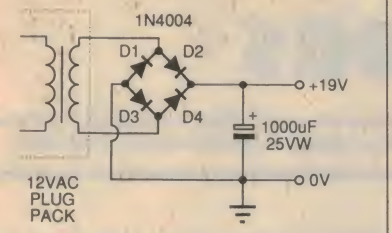


Fig.5

circuits, it works well. In diode logic circuits, some impedance has to be sacrificed to get a good voltage change at the output. Here's our first area we'll leave for you to experiment with. Try changing the resistors around, but don't go lower than 10kΩ.

Voltage rectifiers

There is at least one of these in most mains powered household appliances, except those running special power supplies called 'switchmode' supplies.

There are three basic topologies that the designer can use with a standard AC plug pack. The first of these is the half-wave rectifier in Fig.3. The diode simply allows the positive half of the AC waveform to pass through, but blocks the reverse half.

While this circuit is simple and uses only one diode, the 1000uF capacitor is only 'topped up' every other half cycle. This results in a drop in the output voltage on high demand loads. The DC output also has a fair amount of AC ripple. This can be reduced by increasing the capacitor value, but it will always be relatively high with this circuit.

One thing to notice with this and other voltage rectifier circuits is that the output voltage is higher than the rated transformer voltage when there is little or no load connected. As a rule of thumb, you can multiply the RMS voltage of the transformer by the 1.4 to get the final DC voltage.

Fig.4 is a logical extension of this circuit and uses the negative half of the AC waveform to produce a negative supply. In effect, it is a simple way to double the output voltage — because the absolute voltage between both active outputs is now 38V. (You can measure this by placing the positive lead of your multimeter on the positive output and the negative lead on the negative output.)

Again, the circuit suffers from the problem that each output is only topped up on alternate half cycles, and really requires a regulator after it to provide a practical supply for circuits using logic ICs, etc.

A much more rugged supply can be constructed using the circuit in Fig.5. This full-wave rectifier requires four diodes to produce one supply rail, but it uses both halves of the AC waveform to top up the capacitor. The benefit here is when you have a heavy load connected to it. The output voltage under that load will only drop down to around the transformer voltage — i.e., 12V DC with a 12V RMS transformer — whereas with the previous circuits the voltage can drop down to half the transformer voltage, i.e., 6V. (In practice, it's around 9V, but is dependent upon the current rating of the transformer and the size of the output capacitor.)

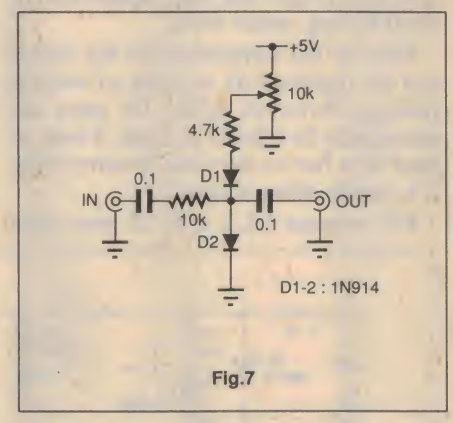


Fig.7

Again, the 1.4-times rule works here in working out the DC output voltage of Fig.5, but because of the full wave rectification action, this figure holds for heavier loads.

These three circuits can form the basis of just about any power supply, but some form of voltage regulator such as a 78XX type chip is recommended.

Voltage multiplication

In one of the previous circuits (Fig.4), we touched on the concept of voltage multiplication. The circuit in Fig.6 takes this idea another step further. By adding two more diodes and capacitors, we can increase the output voltage to 26V on each supply, or 52V in total from just a 12V plug pack. It must be remembered, though, that this is at a much lower current than the original 12V rating. Whenever you increase the voltage, you inevitably reduce the output current.

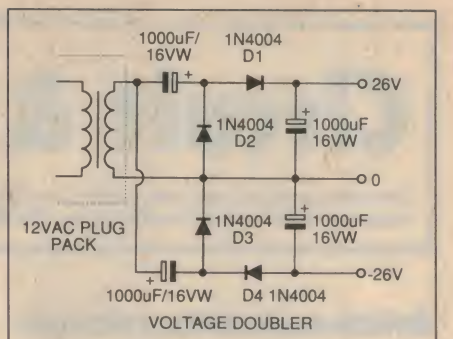


Fig.6

Be that as it may, it is a very useful circuit to have on hand when you need a higher voltage, for example for operating old Telecom telephones or some electret microphones.

One thing that should be mentioned here is that the diodes must have a voltage rating of more than the output voltage divided by the number of diode stages. In our case with an output voltage of 26V per side, dividing this by the two diode stages means that each diode must be rated for at least 13V. The 1N4004 diodes used in the circuit are rated at 400V, which is fine.

If you have a few 1N400X diodes lying around, it is fairly easy to work out the voltage rating. The final digit in the code represents the voltage rating, so 1N4001 are 100V, 1N4002 are 200V and so on up to 1N4004. The 1N4007 type is rated at 1000V.

Audio modulation

The ideal diode would allow all current to flow in one direction and none in the other. But as we know, the PN junction of a diode means that the anode of the diode must be 0.7V above (i.e., more positive than) its cathode for current to flow; and even this isn't strictly accurate.

What actually does happen is that as the anode vs cathode or 'forward voltage' of the diode increases, the diode is pushed further into conduction and more and more current flows through it. In a crude way, what we have is a voltage-controlled resistor,

Continued on page 97

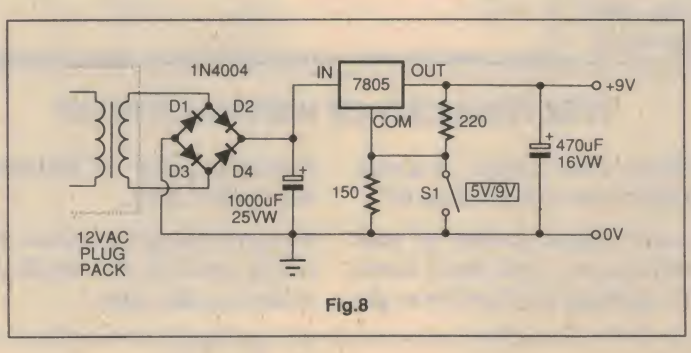


Fig.8

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Switch-mode battery charger

This circuit is a 12V 0.5A switch-mode battery charger based on a simple 74C14 CMOS IC. It was designed specifically for charging small lead-acid batteries (gel cells) from a car's electrical system. The circuit uses voltage boost, so it can work whether or not the car is running. It can also operate from larger input voltages, including an unregulated DC supply like a battery charger. The input supply range is about 8 to 24 volts, but if the unit is powered from voltages less than 18V, omit R6, D8 and D9.

Briefly the circuit operates as follows. Initially Q1 and Q2 are off and capacitor C1 charges via R1. When C1 charges to the upper threshold voltage of IC1a, the output of IC1a switches low. This level is inverted and buffered by IC1b, c and d, causing MOSFET Q1 to switch on.

Current in L1 now rises linearly to about 1.2A, switching on Q2 (via R2) which rapidly discharges C1, causing the MOSFET to turn off. The inductor current is now forced to flow through D1 and into the battery being charged. Meanwhile C1 recharges and about 10 to 15 microseconds after Q1 turns off, the cycle repeats.

Inverters IC1e and f form a sensing circuit which automatically shuts the circuit down if a battery is not connected to the output terminals of the charger. This protects against excessive power dissipation in D2 and D3, and also makes the output terminals short-circuit proof. (Note that the output terminals must *not* come in contact with the input terminals.)

Zener diodes D2 and D3 divert some of the charge current as the battery approaches full charge. However their most important function is to protect against over-voltage should the battery be in a high impedance state, or if there is excessive inductance in the output leads.

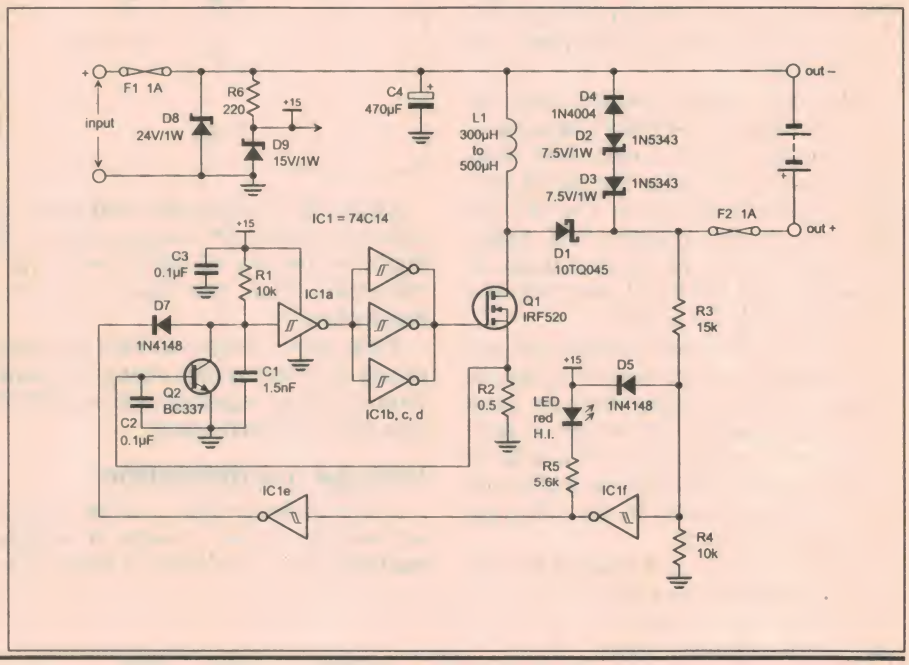
For efficient operation the output wiring inductance must be small in relation to L1, so use output leads that are as short as possible. Adding a capacitor across the output terminals to overcome this limitation will prevent the battery sense circuit from working. If you need a long lead length, use long input leads instead of long output leads.

Most of the components in the circuit can be replaced by devices of similar ratings. However, while D1 need not necessarily be a Schottky type, it must at least be a fast or ultra-fast recovery type if a regular diode is used.

For inductor L1, I used 45 turns on a P26/16 ferrite pot core with an air-gap of 2mm x 0.55mm. Either a powdered-iron core or an air-cored type should work, but a laminated-iron core is not recommended as the ripple frequency is about 50kHz. A small heatsink (about 21°C/W) is needed on the MOSFET.

As it stands, the circuit is not protected against undervoltage conditions. That is, if the supply is maintained at about 5 - 6 volts the MOSFET will fail to switch, remain in linear mode and become hot. Though this could be overcome by some additional shut-down circuitry, a simple solution is to use a logic level MOSFET with a fairly low on-resistance for Q1. Then if the voltage is low enough to make the circuit go 'linear', the power dissipation would be only a few watts.

Stewart Whitlog,
Charlestown, NSW. **$45**



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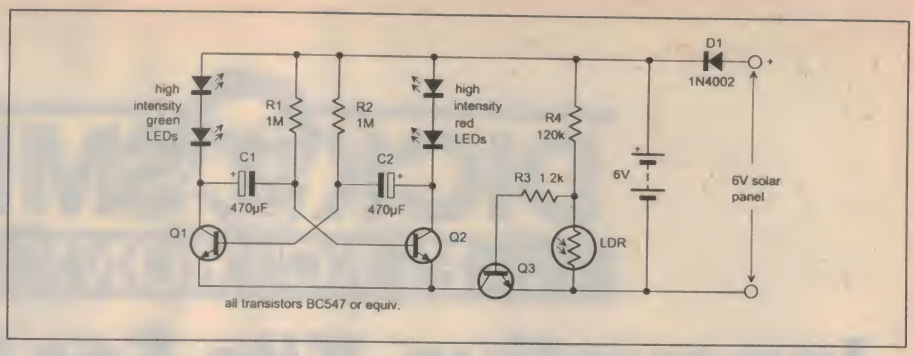
Solar night light



This circuit can be used as a night light in a bedroom. It has the advantage of being troublefree, charging from light during the day, and switching on automatically when the light level drops. It was originally designed as a fish tank light, illuminating the tank at night.

The circuit is made up of three parts: a very simple solar-powered battery charger, a light level sensor and a multivibrator.

When the light level is high enough, the battery is charged from the 6V 1W solar panel (Jaycar ZM-9020). When the light level falls sufficiently, charging stops and the resistance of the LDR increases, allowing Q3 to turn on. This causes the multivibrator to start operating, in turn alternately switching on the high intensity green and red LEDs.

The level of light required to cause the multivibrator to start operating can be set with the value of R4. Increasing the resistance of R4 makes the circuit operate at a lower light level. The on-time of the LEDs can be lengthened by increasing the values of C1 and C2, or of R1 and R2.

Sammy Isreb,
Traralgon, Vic. **$25**

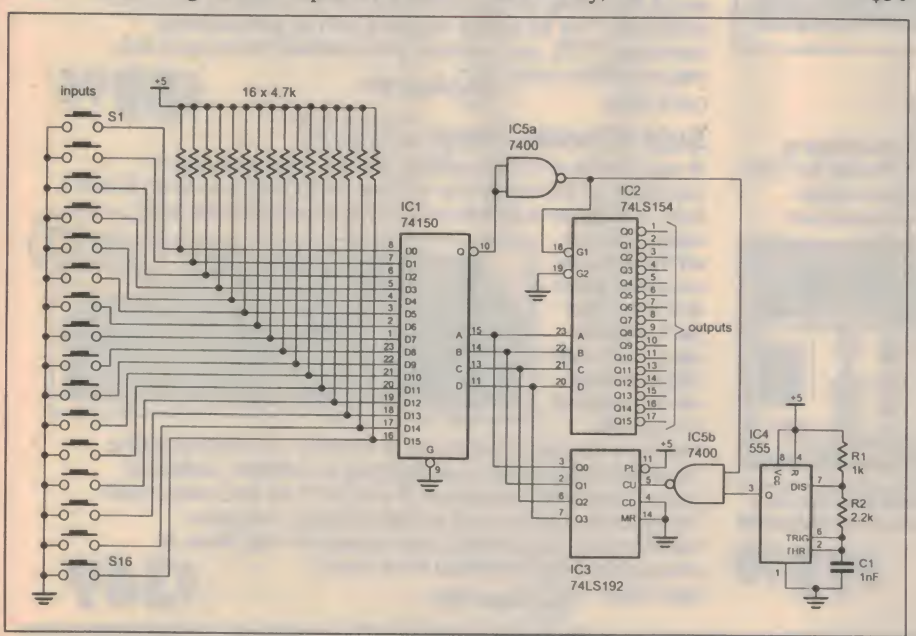
First-event indicator

This circuit can determine which event out of several happened first. The circuit provides a one-and-only-one output, from a total of 16 possible inputs. The circuit can be used in a game show to indicate which contestant responded first, or the switches could be replaced with TTL compatible inputs for applications like a model race track, to show which car won the race.

The design is based on a 74150 TTL multiplexer, a 74LS154 demultiplexer and a 4-bit binary counter (74LS193). Initially all switches are open, and pin 10 of IC1 is low, enabling the gated clock oscillator made up of IC5b and IC4. As a result, the counter generates a 4-bit address that sequentially scans all the switch inputs, as well as sequentially addressing each output of IC2. When a switch is closed, and the counter reaches the input the switch is connected to, pin 10 of IC1 goes high, sending a low via IC5a to the input of IC5b, which disables the clock signal to IC3. As well, pin 18 of IC2 is now low, and the corresponding output for the particular switch goes low. The clock remains disabled as long as the switch is closed. Closing the other switches at this time has no effect on the outputs. Once the switch is opened, scanning continues.

The main advantage of this circuit is that only a few ICs are required. The circuit can be extended with additional devices for IC1, IC2 and IC3. The speed of the clock should be as high as possible, but around 200kHz will suit most purposes.

George Katz,
Dee Why, NSW. **$30**



Etching PCBs

I have been using this simple method for fast etching PCBs for many years. Rather than using ferric chloride solution, this method combines hydrochloric acid and 40% hydrogen peroxide in a 1:3 ratio. Small PCBs can be etched in about 30 seconds.

Treat these chemicals with respect and avoid skin contact. Etch within reach of running water, with proper ventilation. The reaction releases quite a lot of heat, which speeds up the process. A splash of water can be used if the fizzing gets too violent.

Double coat the PCB with etch resist, as the reaction's heat can affect quality. Etching is done in any plastic or glass container. Mix the etchant just before use as peroxide decays quickly. No sediment is formed, so place the board copper-side up and gently rock the container to disperse heat. The 1:3 ratio is critical, but more peroxide is better than less.

The peroxide is also available in supermarkets, but at a lower concentration. I have used this peroxide, but it has a longer etching time. A galvanic cell can be used to compensate, which is done by soldering a resist-coated copper wire to the PCB on one end, and attaching a carbon rod from a used torch battery to the other. This is then immersed in the etchant.

Barrie Castle,
Bakara RSD, SA. **$25**

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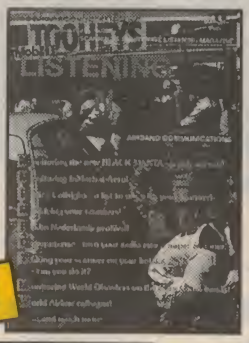

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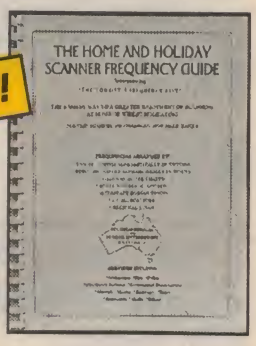

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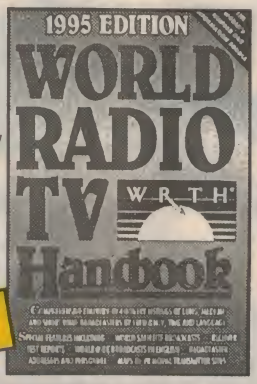

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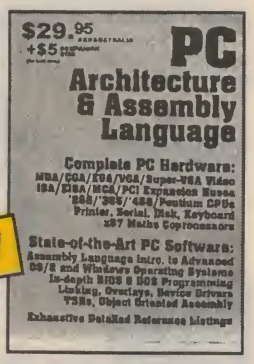

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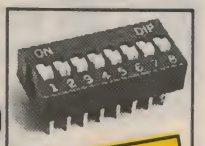

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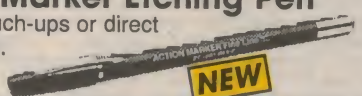

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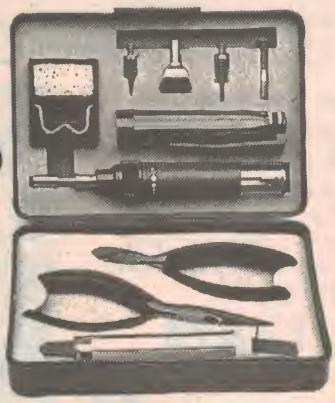

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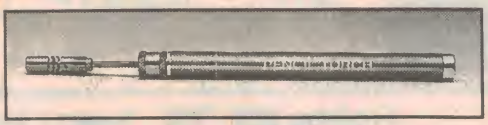

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STORES ACROSS AUSTRALIA AND NEW ZEALAND

Construction Project:

SMART DOOR MINDER

You've seen them all over the place — but have you ever had to live with one? They are usually very simple designs which can't tell whether someone has gone in or out, and tend to buzz incessantly if someone stands in the beam. This design fixes those problems, and has a couple of other bells and whistles too...

by GRAHAM CATTLEY

The idea of a door minder is not new. Several designs have been presented in *Electronics Australia* over the years, but we felt that what the world *really* needed was a door minder with intelligence: a door minder that knew the difference between 'in' and 'out'; a door minder that wouldn't buzz forever if someone (or something) stood in the way, but also wouldn't shut up completely if an errant umbrella blocked the beam. Well, this is it — and by keeping the design simple, it doesn't cost much to build, either.

The main feature of this design is the ability to let you know which way someone went through the doorway, and also let you know if the beam has been blocked for any length of time. Also by mounting the light source in the case along with the rest of the circuitry, the door minder can be installed with a minimum of wiring, and can easily be moved to another location if desired.

But why do you need a door minder? Well, if you have any kind of business, some sort of door minder is a must — if only to let you know when customers (and/or merchandise) are leaving the shop.

By connecting the unit to a digitised speech recorder, customers could be greeted on entering the shop and asked to come again on leaving.

Having it connected to a digital counter is also very useful, as you can match the count against the number of sales for the day and see how many customers were 'Just looking'...

Don't have a shop? A door minder can also be very useful in the home — for things like letting you know if your toddler has strayed into the kitchen. There are, of course, more frivolous uses, such as seeing exactly what time Tiddles gets home at night, but we leave these applications to your imagination.

How it works

This door minder differs from most other designs, in that the light source is mounted in the case along with the sensors. This eliminates the need for extra wiring to a light mounted on the other side of the doorway, and also makes the unit easier to install.

Visible light was used for the beam for two reasons. One is that infrared LEDs and detectors are expensive and would require a more complex circuit; and two, light bulbs produce a far brighter beam, allowing the unit to operate reliably over greater distances.

By using a parabolic reflector from a cheap torch to direct the beam, and a small mirror to reflect the light back again, the cost of the project is kept to a minimum without the need for any fancy (read 'expensive') optics.

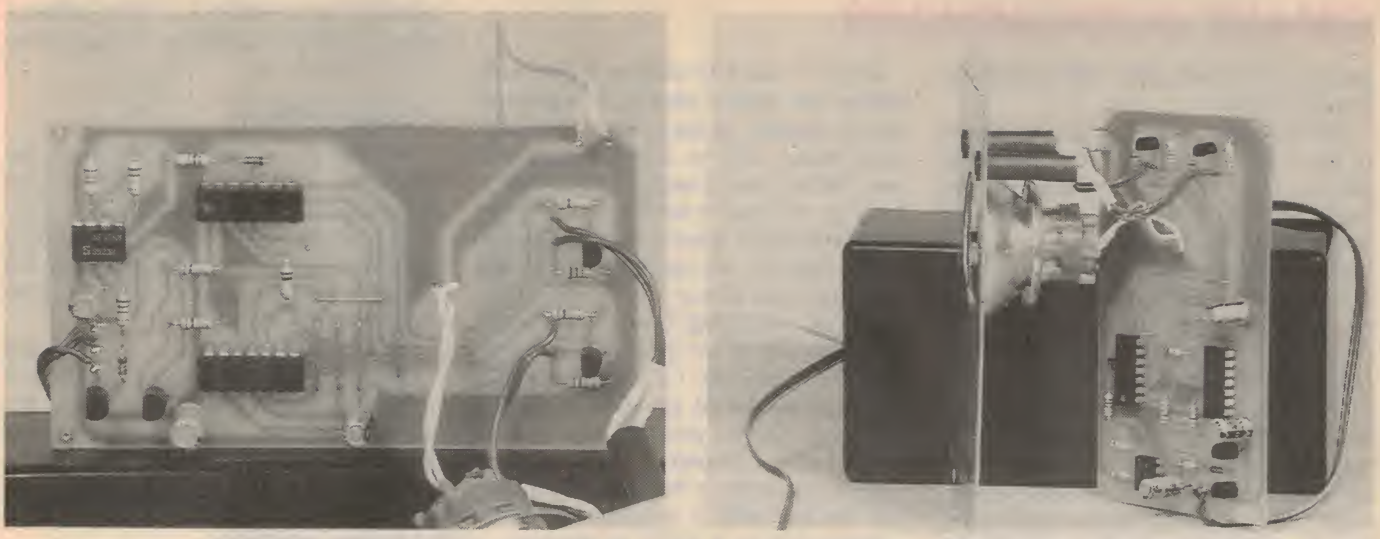
And while the unit was designed as a door minder, giving one tone for entry and another for exit, the unit can easily be put to all sorts of other uses. For example it could be used to operate an automatic light switch, which turns the lights on when you walk into a room and turns them off again when you leave.

The door minder also has a buffered output, suitable for connecting the unit to a digital counter, or to a LED to provide a visual indication that someone has walked in.

Circuit description

The design of the circuit is based on the fact that the two sensors (LDR1 and 2) are mounted horizontally, and that an object passing through the doorway will break a beam going to one of the sensors before breaking the other. By detecting which beam was broken first, the unit can indicate which way the object was moving.

Light is directed out of the front of the door minder and is

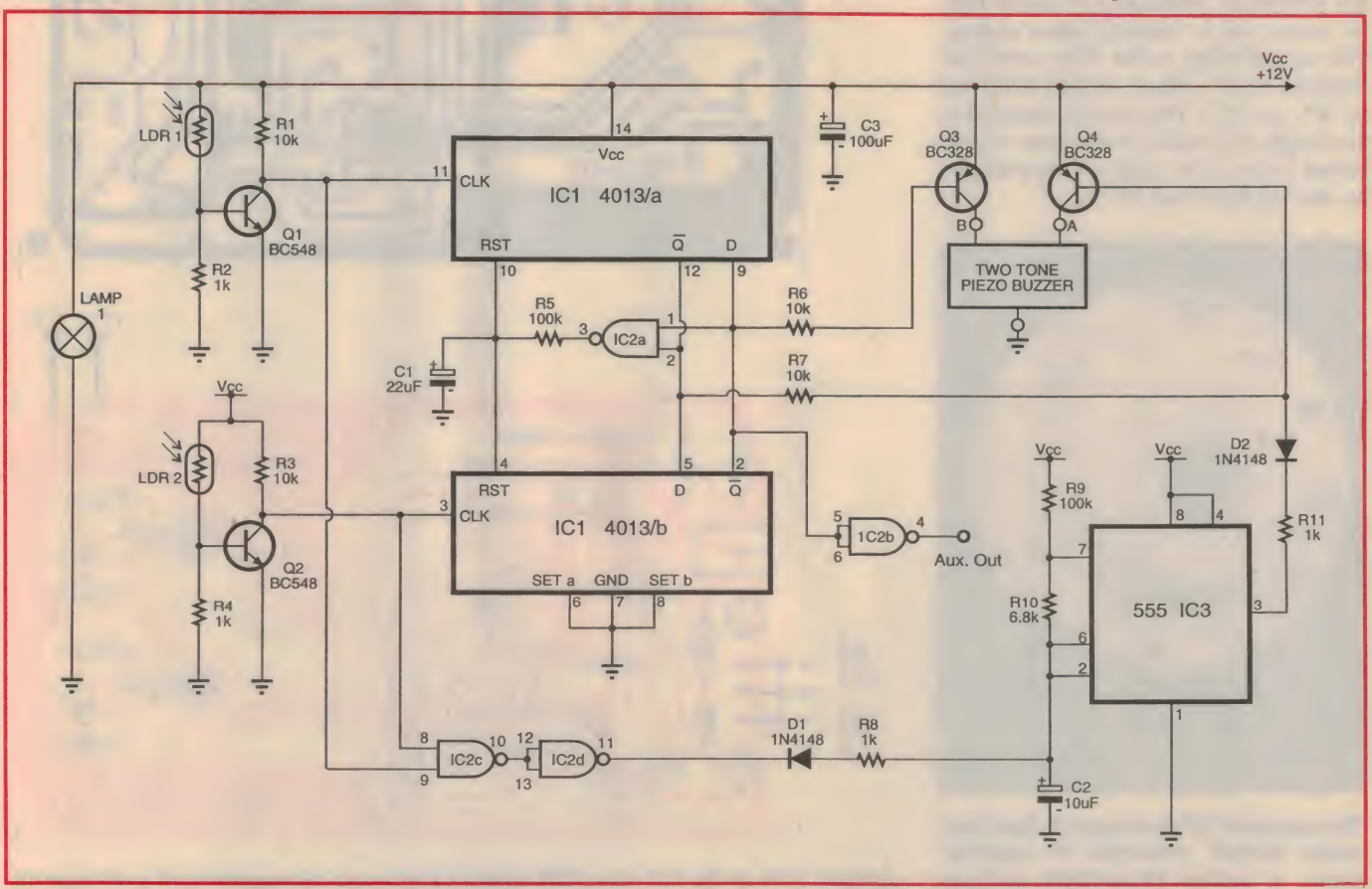


Left: A close up showing the wiring to the PC board. Note that PC pins were not used to connect the lamp and LDRs, in order to provide clearance for the reflector. Right: The LDR director tubes are clearly visible in this shot, with the lamp/reflector assembly mounted beneath them.

reflected back to the unit by a mirror mounted on the other side of the doorway. The reflected light normally hits both LDR1 and LDR2, and accordingly their resistance drops. The base voltages on transistors Q1 and Q2 rise, and the transistors turn on, bringing their collectors low.

R2 and R4 set the sensitivity of the unit, and their values may need to be changed if the doorminder is used in very a bright environment.

IC1 is a dual D-type flipflop with each of the flipflop's data inputs connected to the other's Q-bar outputs. When both flipflops are reset on power up, each sees a low on its data input and clocks this onto its (unused) Q output. The resulting high on each Q-bar output turns off both output transistors Q3 and Q4. As the clock inputs to IC1 are positive edge triggered, the steady low on the input transistor collectors has no effect on the inputs, and the circuit



The complete circuit diagram for the smart door minder. IC1 detects which light beam was broken first, while the 555 serves to pulse the buzzer once a second if both beams are broken.

remains in a steady state until something breaks a beam.

When a beam is broken, the resistance of the associated LDR rises, and turns off the transistor. In turning off, the transistor's collector voltage rises, and this 'rising edge' appears on the clock input of the flipflop. The flipflop clocks, and transfers the high appearing on its data input through to its Q output — and conversely a low on its Q-bar output, turning on the output transistor.

Of course any object moving through the doorway will break the second beam a short time after the first. However, as the data inputs are seeing inverted forms of the other flipflop's output, and as this data has already been set to zero by the previous beam being broken, the Q-bar output of the second flipflop remains high. This whole procedure works either way around, with the end result being that only the first beam broken has any effect on the outputs.

Once one of the Q-bar outputs goes low, two things happen. The first is that the appropriate output transistor turns on and supplies power to the the buzzer — a two-tone piezo buzzer was used in the prototype, producing a steady tone for entry, and a 'chirrup' when exiting. The second thing is that IC2a resets the flipflops, after a three second delay set by R5 and C1. This delay determines the length of time that the buzzer sounds before being reset, and can be changed by altering the value of C1.

IC2c is used to detect when both beams are broken (that is, when someone is standing in the beam). Obviously both beams *will* be blocked in normal use (unless you're *awfully* thin), but so long as you move through both beams within the three second sounding period of the buzzer, the output of IC2c will not have any effect on the circuit. If, however, something blocks both beams for more than three seconds, the output of IC2d goes high, C2 charges through R9 and R10 and the 555's output switches Q4 on and off at a rate of around once a second.

IC2b provides a buffered logic output for use with a counter, or can be connected to a LED to provide a visual output.

Because of the relatively high current drain due to the light source, the door minder is powered by a 12V DC 250mA plug pack. C3 serves to decouple the supply near IC1.

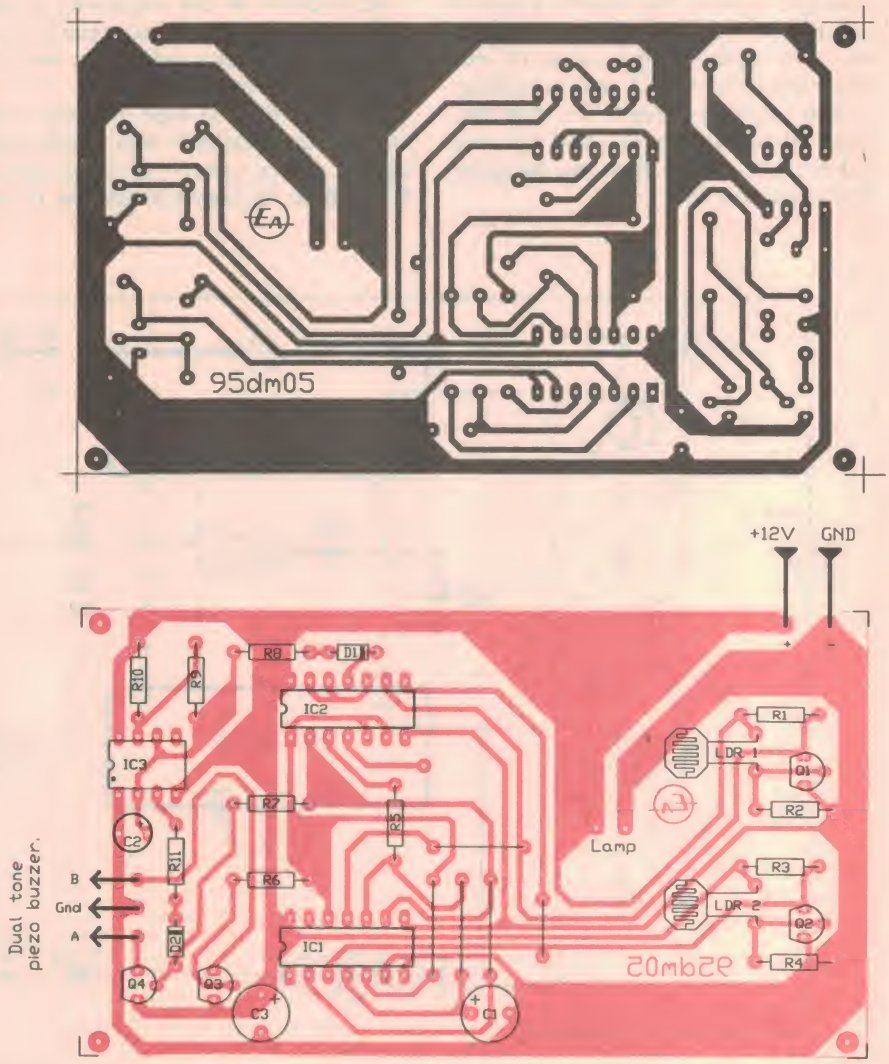
Construction

As you can see from the photos, the circuitry for the door minder is all mounted on a PC board measuring only 105 x 60mm, and coded 95dm05. This fits into a small UB3 jiffy box, with the lamp reflector and LDR light director tubes fitted to the box lid.

The PC board is quite uncluttered and the components can be installed in any order, but it is easier to install the five wire links, resistors and diodes first. Observe the normal anti-static procedures when installing IC1 and IC2, and don't mount the LDRs, lamp or buzzer until later.

The door minder uses a parabolic reflector out of a cheap torch to focus the beam on to a mirror mounted on the

The source of all the noise! A dual tone piezo buzzer mounted in another room. A series 1k resistor can be placed in the ground lead to keep the volume down.



Above: This is the full size PCB artwork for those who make their own boards. Below: Here's the parts overlay — use it as a guide when fitting the parts on the board. Note that the lamp and LDRs are connected with short lengths of wire.

Smart Door Minder

The front panel has been designed to accommodate almost any size reflector. Simply cut a hole of the required diameter.

other side of the doorway. Almost any torch will do, but the bigger the reflector the better — a 4cm diameter reflector was used in the prototype, with excellent results.

You will no doubt find that the only torch bulbs available to suit the reflector (flange mount), have a voltage rating of 2.4 to 4.6 volts, and not 12V as required here. To get around this problem, the existing bulb mounting hardware was removed, and an Edison screw bulb socket was glued into place. It was then a simple matter to solder two leads to the socket, and install a 12V ES bulb.

A large circular hole has to be cut in the front panel, the diameter being just under the diameter of the reflector. Use a nibbling tool to remove most of the aluminium and file the hole to size — a couple of millimetres smaller than the reflector should be about right. Drill the two 6mm holes for the LDRs and a hole in the end of the case for the power and external buzzer leads.

Carefully glue the reflector into place behind the lid with five minute epoxy, and while you are at it, glue the ES bulb socket into the reflector. A small tip here: If possible, assemble the bulb socket, bulb and reflector before glueing and apply power to the bulb. Position the socket in the reflector so that the reflector directs a concentrated spot of light on a wall, approximately two metres away. Mark the position of the bulb holder so that when glueing, the holder can be aligned easily.

The two LDRs are soldered to 5cm lengths of wire and installed on the board — use a bit of heatshrink sleeving on the leads to prevent them from shorting. Solder the leads from the lamp to the board, and thread the power and buzzer leads through the hole in the end of the box. If you want to mount the buzzer remotely, use some three-core cable to run from the door minder to the buzzer.

The LDRs are mounted on the front panel using a LED mounting bezel and a 25 x 6.4mm piece of heatshrink — see Fig.2 for the mounting details. (**Note: Do not shrink the 6.4mm heatshrink — the LDR and LED mounting clip just push neatly into the heatshrink, although a touch of glue to hold the lot together wouldn't be a bad idea.**) Mount the PCB in the bottom of the box using a couple of pieces of double-sided foam tape, remembering to leave clearance for the reflector, and screw the lid onto the box.

Testing, testing

The completed door minder can easily be tested by placing a small mirror about 20cm in front of it, and switching on the power. If all is well, the buzzer should sound for about five seconds and turn off. By covering each LDR in turn with your finger to simulate someone passing through the beam, you should hear one tone in one direction and another in another.

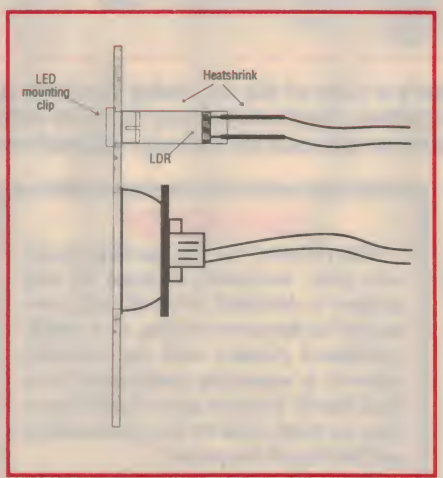


Fig.1: This diagram shows how to mount the LDRs. Only the front half of the LED mounting clip is used, with the heat shrink holding it in place.

PARTS LIST

Resistors

All 1/4 watt 5%:

R2,R4,R8,R11	1k
R10	6.8k
R1,R3,R6,R7	10k
R5,R9	100k

Capacitors

C1	22uF 25VW electrolytic
C2	10uF 25VW electrolytic
C3	100uF 25VW electrolytic

Semiconductors

LDR1,LDR2	Light Dependent Resistor DSCD01 (or equiv)
D1,D2	1N4148 or similar diode
Q1,Q2	BC548 NPN transistor (or equiv)
Q3,Q4	BC328 PNP transistor (or equiv)
IC1	4013 CMOS dual D flipflop
IC2	4011 CMOS quad NAND gate
IC3	555 timer IC

Miscellaneous

PCB coded 95dm05, 60 x 105mm; Plastic box to suit, size 41 x 68 x 130mm (UB3); Torch reflector and bulb assembly; 12V ES light bulb; ES lamp holder to suit; Two pieces of 6.4 x 25mm heatshrink; Two LED mounting clips; 12V dual tone piezo buzzer; 12V 250mA DC Plugpack; Hook-up wire etc.

If you can't seem to get both beams to work, try removing the lid and checking that both LDR director tubes are parallel, as they may have been pushed out of alignment when positioning the lid.

As the door minder only weighs about 100 grams, it can be mounted on a wall or door frame with double-sided foam tape. If the unit is to be permanently mounted, the leads going to the plug pack and buzzer could come out of the back of the box and run through the wall cavity to a remote on/off switch and buzzer.

A small mirror 50mm square was used as a reflector, but almost anything similar could be used. This is mounted on the opposite side of the doorway and, again, double-sided foam tape comes in rather handy.

The easiest way to align the door minder and reflector is to secure the door minder to one side of the doorway and switch it on. Manually position the reflector so that the reflected light hits both LDRs equally, and then secure it in place. Substituting a couple of LEDs (with 1k dropping resistors) for the buzzer makes this a much quieter procedure.

There isn't a lot more to say, except that if you have any pets of the four-legged variety, make sure that the unit is mounted above tail level — for obvious reasons! ❖

Construction Project:

Mains Appliance Remote Controller - 2

Here's the construction details for the UHF remote controlled mains appliance controller whose circuit was described in the March issue.

by JEFF MONEGAL and PETER PHILLIPS

The circuit is built on two PCBs, which are then linked together as shown in the photo of Fig.4. The receiver/timer PCB is quite crowded, but should present few problems to build. Start by thoroughly inspecting the board for track errors and shorts. There are quite a few tracks running between IC socket pads, which means you'll need a reasonably fine soldering iron and small-diameter solder for many of the connections.

Now install the links, especially the one under IC1. There are also two links fitted to the track side of the board. One of these is link B, which is fitted if you don't want the timer option. See the photo in Fig.2. Otherwise fit link A (on the component side of the board). All components other than R20 are mounted vertically. IC sockets are optional.

The UHF receiver is inserted with its component side facing out. LEDs 1, 3, 5, 7, 9 and 11 are fitted on the track side of the board, mounted high enough to poke through holes drilled in the front panel.

In the prototype, the whole assembly was attached to a wall plate, with spacers that were glued to the back of the plate. If you do the same, allow for the length of the spacers when installing the LEDs.

The optocouplers are made by fitting a high brightness LED hard up against an LDR, both supported in heatshrink tubing. Place the LED and the LDR into the tubing so they touch each other. Slowly heat the tubing so it shrinks down evenly, making sure the two components remain hard up against each other. Use black tubing, as it makes an excellent shield against light. Then paint both ends with black nail polish, or similar, to give a completely light tight assembly. This is important, as if any external light is allowed to influence the LDRs, speed variations between settings will be unpredictable.

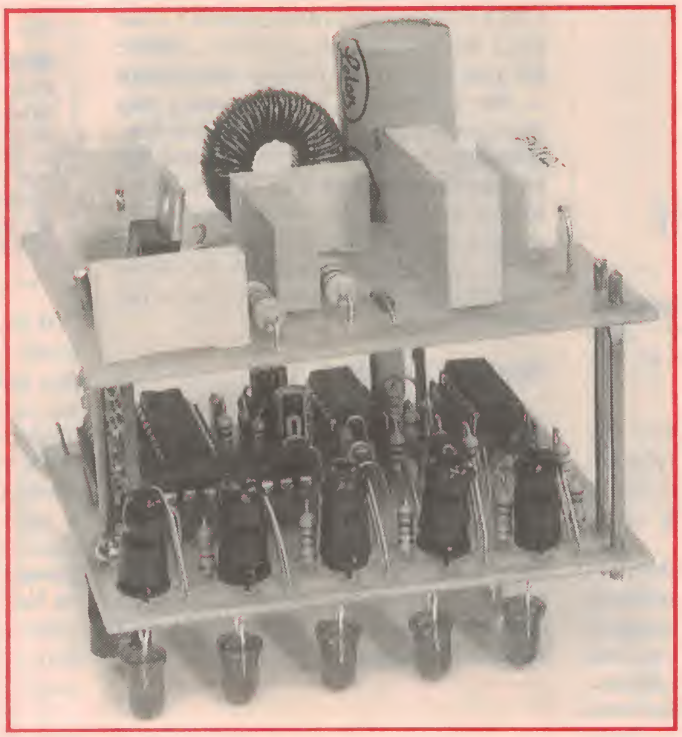


Fig.4: Here's a view of the assembly from the optocoupler side. The 250mm length of antenna, the 240V active lead and a connection to the load are the only external connections.

The assembly is fitted to the PCB with the LED at the bottom. As shown in the layout diagram, the LED connects to the pads on the left side. The leads from the LDR are formed to drop down to the pads on the right of those for the LED. All five optocouplers are mounted this way. Note the polarity of the LED, with the anode towards the outside of the board. (By the way, the LEDs supplied in the kit will most likely have the long lead as the *cathode*, not the anode as is usual.)

The transmitter will be supplied as a kit, with instructions on how to build it. This is a relatively easy and quick task.

WARNING!

The circuitry for the receiver/timer and triac controller sections of this project is designed to be directly connected to the power mains. As a result, accidental contact with the circuitry when it is operating could result in a fatal shock. Extreme care should therefore be used, both in the construction and testing of the project.

If you are not experienced in working with this type of circuit, we strongly recommend that you do NOT attempt to build the project.

The controller PCB has mains voltages applied to it, so be sure it's properly soldered and built. The tab of the triac faces towards the centre of the board, and you'll probably need to form the centre lead at an offset to suit the PCB pads. The toroid is wound on a 15mm core, and mounts vertically. If you are winding your own toroid, use 0.8 to 1mm diameter wire, and wind two layers on the core. Varnish the coil after you've wound it.

If you add a heatsink to the triac, it's a good idea to insulate it from the tab with

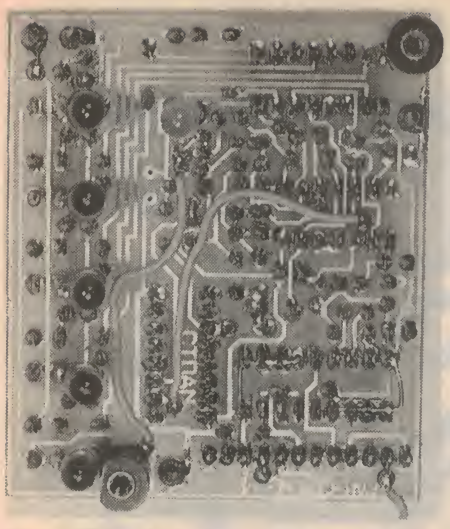


Fig.2: This shot shows the track side of the receiver/timer PCB. The plastic spacers mount the assembly to a wall plate or inside a plastic case.

a mica insulating washer. The heatsink can be made from a scrap of aluminium, or you can fit a commercial type. You only need a heatsink for loads above 200VA or so, and most fan motors are well below this figure.

The terminal block has three connection points, but only two are used by the circuit. Use the third point as a loop, perhaps for a neutral wire if you wiring the unit to a line cord.

Testing

The two boards can be tested separately. To test the triac section, connect a 500k potentiometer to points A and B on the circuit board. These two connection points are both adjacent and close to R30.

Connect a 240V 60W (or so) lamp to the terminal block (load), with the other side of the lamp to mains neutral. Then connect the mains active to the terminal block (active).

Place the circuit board so it's not touching any metal objects, then apply power. The worst that can happen is the lamp comes on at full brilliance, indicating a short in the triac or the PCB. If the circuit is working, you should find that varying the potentiometer varies the lamp brilliance.

There's not much that go wrong with this circuit, assuming you've wired it correctly. If the circuit doesn't work, the most likely cause is incorrect soldering, a missing component, or even (dare we say it) a blown test lamp.

The receiver/timer PCB needs an external DC supply of about eight volts. The positive connection is next to the receiver module, and the negative connection is near IC3.

You should be able to observe the indicator LEDs advancing by pressing SW1 (or a piece of wire to simulate SW1) — not when you press the switch, but when you *release* it.

If you hold the switch closed for a second or so, the green LED should light. The selected function (timer or on-off) will depend on the setting of link A or B. The green LED is really

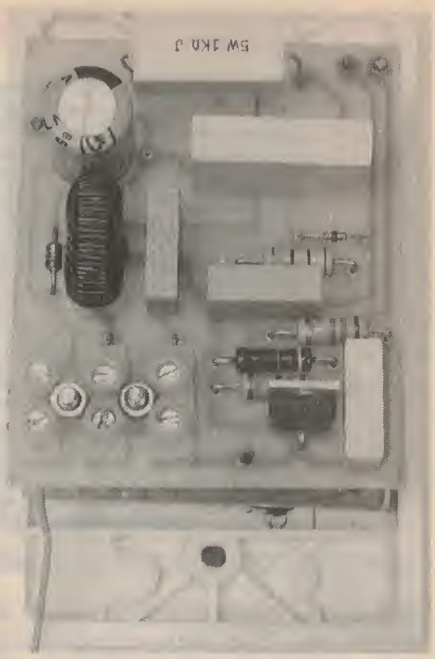


Fig.3: This is a close up of the triac PCB. Mount the 1k 5W resistor (R30) clear of the PCB to allow best heat dissipation. If you fit a heatsink to the triac, remember that the tab is at mains potential.

only needed for the timer mode. In on-off mode, the green LED will come on to indicate power is being applied to the load, but as this is shown by the other LEDs, the green LED is therefore redundant.

If all is working so far, try the UHF transmitter. Pressing the transmitter key

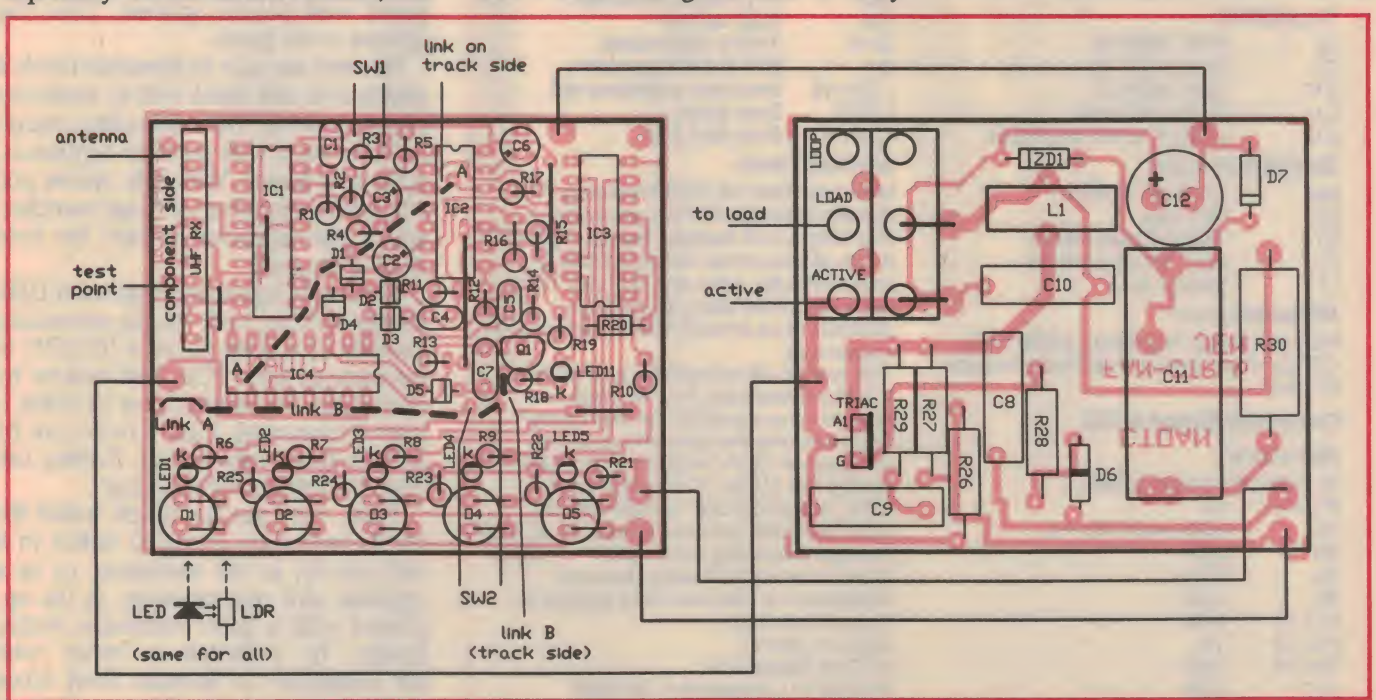
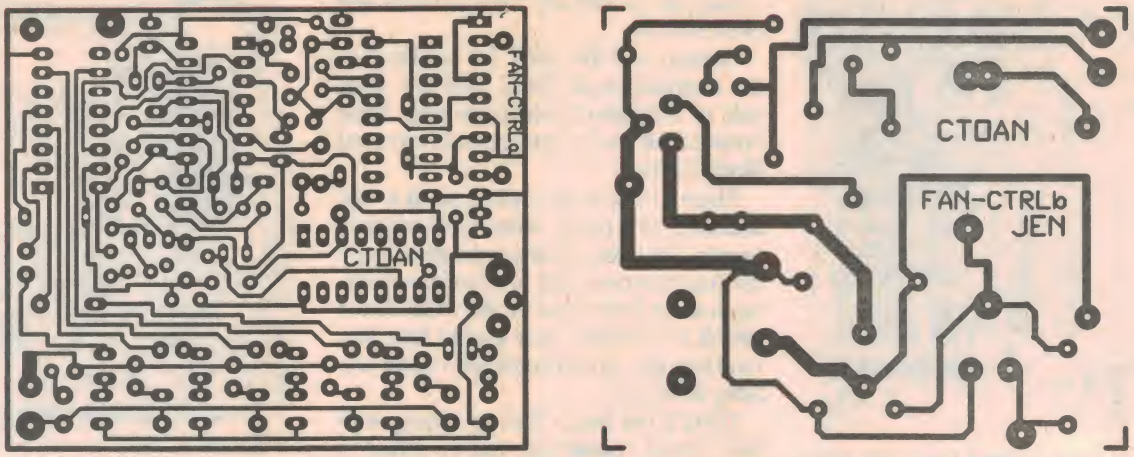


Fig.1: The PCB for the receiver/timer is on the left. Notice the links on the track side of the board. The opto-couplers are connected with the LED on the left, anode to the outside of the board, LDR on the right as shown.

Mains Appliance Remote Controller - 2



Here's the PCB patterns for those who want to make their own. The layout design is copyright to CTOAN Electronics.

should now produce similar results to the switch. The only adjustment to make is the trimmer capacitor in the transmitter. Adjust this for the best operating range, which is usually around 80 to 100 metres.

If you have fitted SW2, operating this switch should reset the circuit so all the red LEDs are out. This switch is the equivalent to turning the triac off with the transmitter.

Final assembly

The two PCBs are held together by four lengths of stiff wire, such as 2mm brass wire available from a hobby shop. These provide connections as well as support for the controller board. Space the boards 30mm or so apart.

For safety, and to protect the boards against corrosion, spray PCB lacquer on the track side of both boards, especially the controller board. This will help prevent breakdown between tracks, if there's moisture or other contaminants in the environment.

You will need to drill five holes in the front panel of the case (or wall plate) for the power level indicating LEDs, and another for the green LED (if used). Then attach the assembly to the front panel with plastic spacers. Glue the spacers to the panel.

The unit can also be mounted inside a plastic case and fitted with an extension plug and socket. This allows the controller to be used with portable appliances, such as a heater. With this option you will have more room to mount switches, and a potentiometer to vary the time delay if required.

To prevent interaction with other UHF remote systems, code the the transmitter encoder IC and the decoder IC (IC1) in the receiver/timer PCB. This is done by connecting the address pins to either a logic 0 (common), logic 1 (+Vcc) or by leaving them open-circuit. Testing can done with all pins open-circuit.

Then, once you've bench tested the whole assembly, install it either in a wall cavity, in the appliance, or as a separate unit that connects to the appliance with a 240V extension socket. Ideally, fit a switch in series with the controller — because even when the appliance is off, there is a small amount of power being consumed by the controller. ❖

PARTS LIST

Controller PCB

Resistors

All 1W, 5%, carbon-film, unless stated:

R26	68k
R27	47k
R28	100 ohm
R29	680 ohm
R30	1k 5W wirewound

Capacitors

C8	47nF 250V AC
C9	33nF 250V AC
C10	10nF 250V AC
C11	0.22uF 250V AC
C12	2200uF 16VW electrolytic

Semiconductors

triac	SC151D 15 amp
D6	ST2 diac
D7	1N4004 silicon diode
ZD1	8.2V 1W zener diode
L1	toroidal core

Miscellaneous

PCB measuring 70 x 60mm coded FAN-CTRLb, three-way terminal block, heatsink (if used).

Receiver/timer PCB

Resistors

All 1/4W, 5% unless stated:

R1,6-10	1k
R2	200k metal film 1%
R3	2.2k
R4	150k
R5	100k
R11,14	330k
R12,13	1M
R15,16	150k
R17	220k
R18	1.5k
R19,20	10k
R21-25	See text

Capacitors

C1,4,5	0.47 mono
C2,6	4.7uF 16VW electrolytic
C3	2.2uF 16VW electrolytic
C7	0.1 mono

Semiconductors

IC1	AX528 trinary decoder
IC2	4584 hex Schmitt trigger
IC3	4017 Johnson counter
IC4	4020 counter
D1-5	1N914 silicon diode
Q1	BC548 NPN transistor
LED1-10	5mm high brightness red
LED11	5mm green
LDR1-5	5mm dia LDR

Miscellaneous

UHF transmitter kit; PCB measuring 70 x 60mm coded FAN-CTRLa; pre-built surface mount UHF receiver module, 150mm length of 2mm brass rod; IC sockets (if used) 2x14 pin, 1x16 pin, 1x18 pin; 75mm black heatshrink tubing to suit 5mm diameter when shrunk; hookup wire, tinned copper wire.

This project will be available as a kit from CTOAN Electronics. A full kit which contains all components for the triac control PCB, including the toroidal core and all components for the receiver/timer PCB including five LDRs, 10 high brightness LEDs, a pre-built UHF receiver module, white wall plate and a transmitter kit...$70.00
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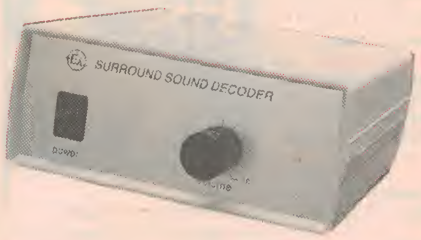

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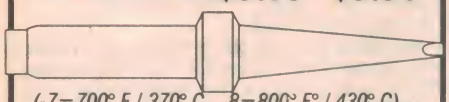

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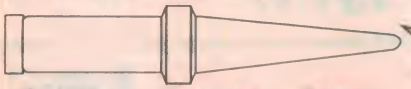

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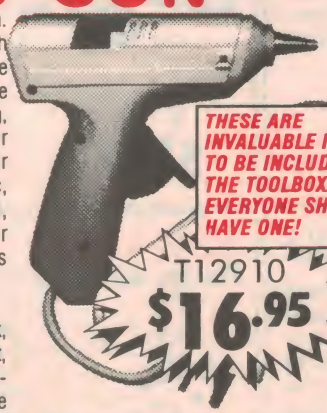

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Construction Project:

ECONOMY SURROUND SOUND DECODER

Perhaps your budget can't quite stretch to the cost of a full 'bells and whistles' Dolby Pro-Logic surround sound decoder. Or alternatively, you might be one of those music lovers who doesn't like the idea of subjecting your favourite music to a lot of fancy digital processing. Either way, this really low cost Hafler-type analog decoder should appeal to you.

by JIM ROWE

Surround sound systems seem to have become very popular lately, either for enhanced music listening or as part of the growing trend towards 'home cinema' installations. And of course the most popular way to provide yourself with surround sound is to use a Dolby Pro-Logic decoder system, either by itself or possibly augmented by a Lucasfilm 'THX' unit for presenting movies.

This type of system can give very impressive results indeed, but it can also be a little 'beyond the budget' for many people. There's also a small, but significant number of people who believe that they can detect a harshness or 'edginess' to the sound from this type of system. One theory used to explain this is that the people concerned may be reacting to the artifacts produced by the Pro-Logic system's digital signal processing.

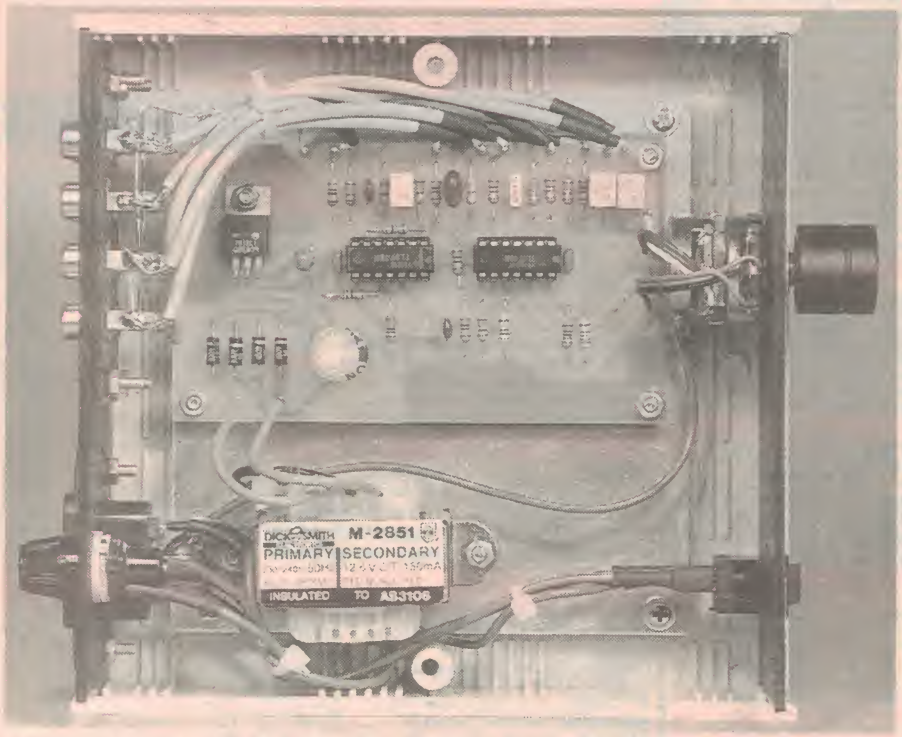
Another complaint often made about Pro-Logic decoders is that they can be rather complex and confusing to set up. Many non-technical people seem to get themselves into quite a tangle, setting all of the levels and variable parameters.

For all of these reasons, then, there's a growing demand for a simple, low cost and easy to use surround sound decoder, using low distortion *analog* circuitry and designed to subject the audio signals to as little 'processing' as possible. That's exactly the kind of decoder we're describing here.

There's nothing terribly new or original about the design. It's based on the same analog subtraction and addition system developed by US engineer David Hafler, back in the early 1970's. Hafler's unit was passive, and connected directly into the loudspeaker circuit; we're simply using the same idea but with op-amps operating on the signals at line level, before the power amplifiers.

A similar, but slightly more complex decoder designed by Robert Priestly was published in the January 1992 issue of *Electronics Australia*, by the way.

I actually developed the present design as part of the recent Stereo TV Sound Receiver, described in the January and February issues this year. It's being described here again separately, because many people asked if we could do this. So here it is, by popular request!

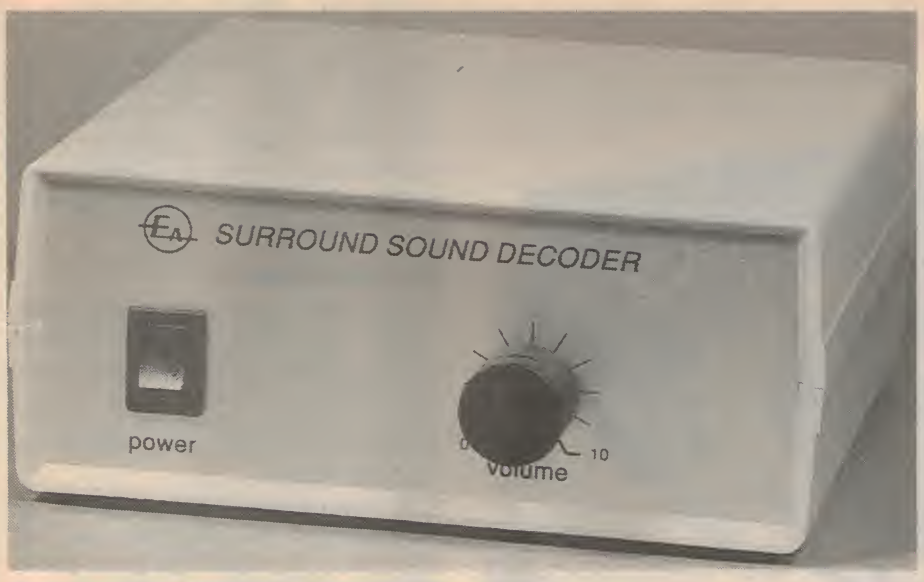


A general view inside the decoder, showing how little circuitry is involved. Most of the parts fit on a small PCB measuring only 110 x 66mm.

How it works

The basic idea behind the Hafler system (and the Pro-Logic system, for that matter) is that although normal stereo audio consists nominally of only two signals, there's really a *third* signal present. This is the 'ambient' or surround information, which is present in 'phantom' form as differences between the main signals conveyed by the left (L) and right (R) stereo signals. By simply subtracting one main stereo signal from the other, we can separate out this 'L-R' surround information and use it to produce a more realistic re-creation of the original sound field.

An elaboration of this basic idea is to perform as well an *addition* of the two stereo signals, to produce an 'L+R' or



mono signal which can be used to drive a 'front centre' speaker, to 'fill in' the 'hole' which can often be apparent in some types of stereo programme material which has exaggerated channel separation. The same 'L+R' signal can also be fed through a low-pass filter to derive a signal for driving a sub-woofer speaker, giving enhanced reproduction of very low frequencies.

All of these operations can be done quite simply, using a small number of low noise op-amps rather than digital signal processing. And that's what we're doing here.

What about a *delay* circuit — don't all surround sound circuits need one of these? Well, it's true that feeding the L-R ambient information through a time delay of around 15 - 20 milliseconds tends to further enhance the 'surround' effect, and that's why a lot of surround sound decoders include a delay circuit. However even without the delay, you can still get a very impressive surround sound effect, with many types of programme material.

In the interests of simplicity and low cost, then, the present decoder doesn't have an inbuilt delay. However if you build or acquire a delay circuit at a later stage, it's quite easy to use it with this decoder. Instead of running the decoder's L-R 'surround' output directly to the amplifier channel used to drive the rear speaker(s), you can feed it via the delay circuit.

Circuit description

As you can see from Fig.1, the actual decoder circuit is quite straightforward, and uses only two TL074 quad FET op-amp chips.

The incoming right and left stereo signals are fed through coupling capacitors C1 and C2, and then to ganged pots VRR and VRL, which together function as a 'master volume control' for all of the decoder's outputs. The signals are then passed through U1a and U1d, connected as unity-gain buffers. The buffer outputs are then fed via R2 and R1 to the decoder's 'Right Out' and 'Left Out' connectors, ready for the main (front) right and left channel amplifiers. The buffers provide relatively low impedance outputs (essentially that of the 680 ohm resistors), to minimise any possible degradation due to the capacitance of connection cables.

The L-R 'surround' or 'rear' signal is derived from these signals by U1c, which is connected so that it simply subtracts one from the other. Resistors R6 and R9 give the stage a gain of -1 as far as the R signal is concerned, but as these also give it a gain of +2 as seen by a signal at its non-inverting input, resistors R7 and R8 are used to restore the gain to unity for the L signal as well. The final output from pin 8 is therefore L-R, as desired.

Resistor R10 and capacitor C6 are used to restrict the bandwidth of this dif-

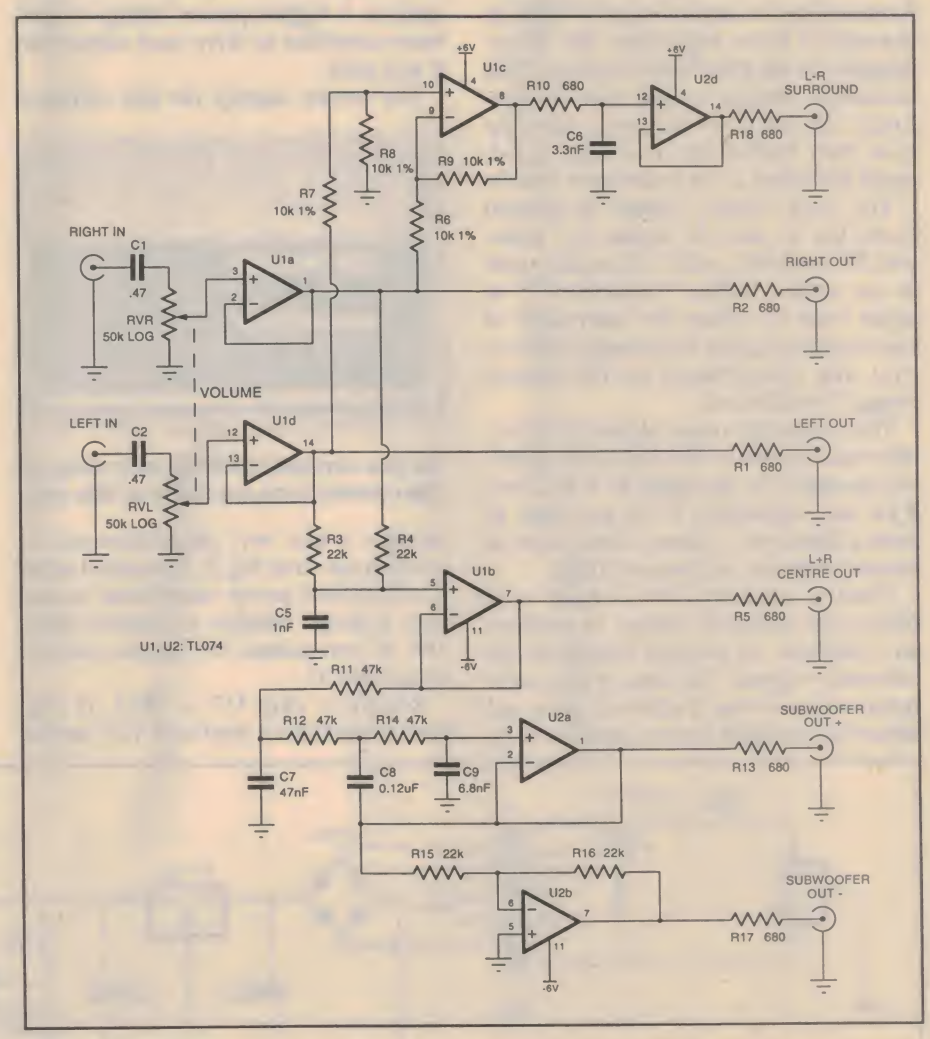
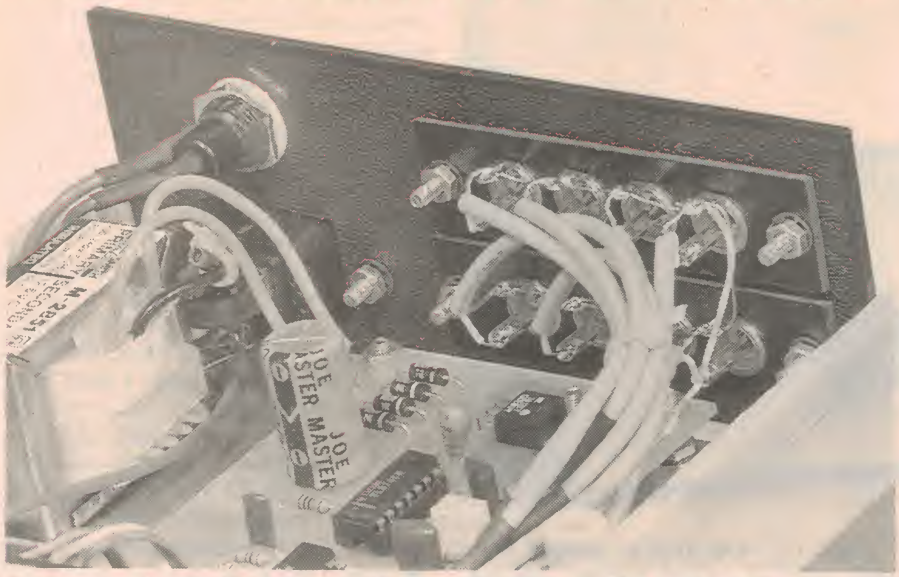


Fig.1: The schematic for the decoder itself, which is basically an enhanced version of the decoder in the author's Stereo TV Sound Receiver. As you can see, it uses only two quad op-amp devices and a handful of other parts.



A close up view inside the case, showing the wiring to the rear panel connectors and some of the mains wiring.

ference signal to approximately 7kHz, to prevent it from degrading the directionality of the front stereo signals. (This bandwidth limiting is also done in Pro-Logic decoders, by the way.) Op-amp U2d then buffers the resulting signal, again providing a low impedance source.

The L+R 'centre' signal is derived from the L and R inputs by resistors R3 and R4, with U1b again used as an output buffer. Capacitor C5 is again used to reduce the bandwidth of the resulting signal to around 7kHz, so that any disturbance to the stereo image is minimised.

The essentially mono output of U1b is also used to derive the subwoofer signal, via op-amp U2a. Resistors R11, R12 and R14 and capacitors C7-9 are used to form a third order low-pass filter, with its corner frequency at close to 100Hz.

Finally, op-amp U2b is used as a unity-gain inverting buffer, to produce an 'antiphase' or inverted version of the subwoofer signal. The idea of this additional output is that it allows a spare and otherwise standard stereo amplifier to be used as a higher power 'bridge mode' mono amplifier to drive your subwoofer, if you wish.

The power supply for the surround

As you can see from this rear view, all the connections are made at this end.

decoder is also very straightforward, as you can see from Fig.2. A standard small 12.6V/150mA power transformer is used with a bridge rectifier to produce about 18V of unregulated DC across reservoir capacitor C11.

Regulator chip U3, a 7812, is then used to produce a regulated 12V output, while remaining op-amp U2c is arranged to establish circuit ground as the centre-tap of the supply — effectively converting it into one of +/-6V. This minimises the need for coupling capacitors in the decoder proper, while still allowing all of the decoder's outputs to have negligible DC component.

Construction

Apart from items such as the master volume control, signal connectors, mains switch, power transformer and mains fuseholder, all of the decoder's other components are mounted on a small PC board. This measures 111 x 66mm, and is coded 95ssd4.

As you can see from the photos, the PCB assembly and other items are fitted into one of the small four-piece plastic utility cases, to form a very compact unit. The volume control and mains switch are mounted on the front panel, while the IEC mains connector, mains fuseholder and signal connectors are all mounted on the rear panel.

Inside the case, the PCB and power transformer are both mounted on a small plate of 1mm aluminium sheet, measuring 115 x 120mm. This provides secure mounting for both, and because it's connected to mains earth it also provides the PCB assembly with a measure of shielding against RF interference.

The earthed plate ensures that the power transformer is also securely earthed, for protection in the unlikely event of a breakdown in the transformer. The metal case of the volume control is also connected to mains earth, both to maximise safety and to provide additional shielding. This allows the decoder's signal ground to be 'floated' with respect to mains earth, to minimise hum loops when the signal input and output connectors are connected to your amplifier system.

The small number of components used in the decoder makes assembly quite a simple task. The overlay diagram should make it easy to fit the smaller components to the PCB, while the photos can

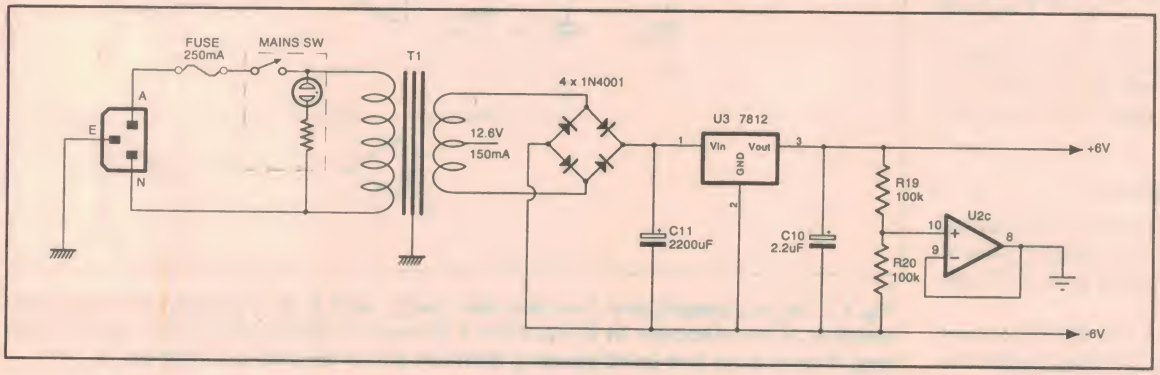


Fig.2: The power supply section of the decoder circuit. As you can see, it's very straight forward and uses only a small number of low cost parts.

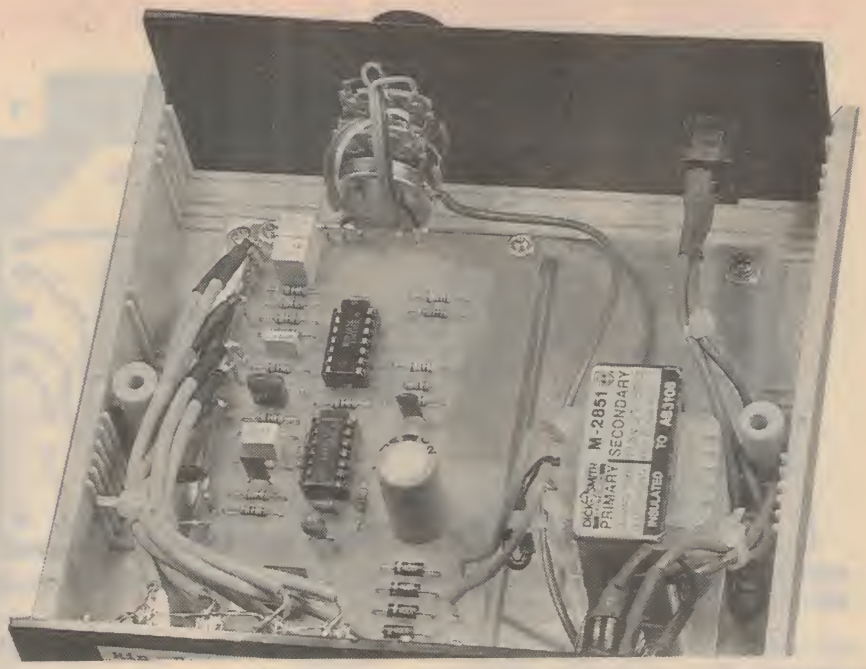
be used as a guide for the rest of the construction.

As usual with this type of project, it's usually a good idea to start the PCB assembly by first checking for any flaws in the board itself. Then fit the PCB terminal pins, which are used later to simplify the off-board connections.

Next you can fit the resistors and diodes, taking care to fit the correct component in each position and to fit the diodes with the correct orientation. Follow these with the smaller MKT and polyester capacitors, and then with the two larger tantalum and electrolytic capacitors. These are again polarised, so keep an eye on their orientation.

Adding the two quad op-amp ICs and the three terminal regulator should complete your PCB assembly. Note that the regulator, U3, doesn't need a separate heatsink in this circuit as its power dissipation is very low. A small amount of heatsinking is provided by laying it down on the board, with a 3mm machine screw and nut both holding it down and also providing thermal coupling to a reasonable area of copper under the board.

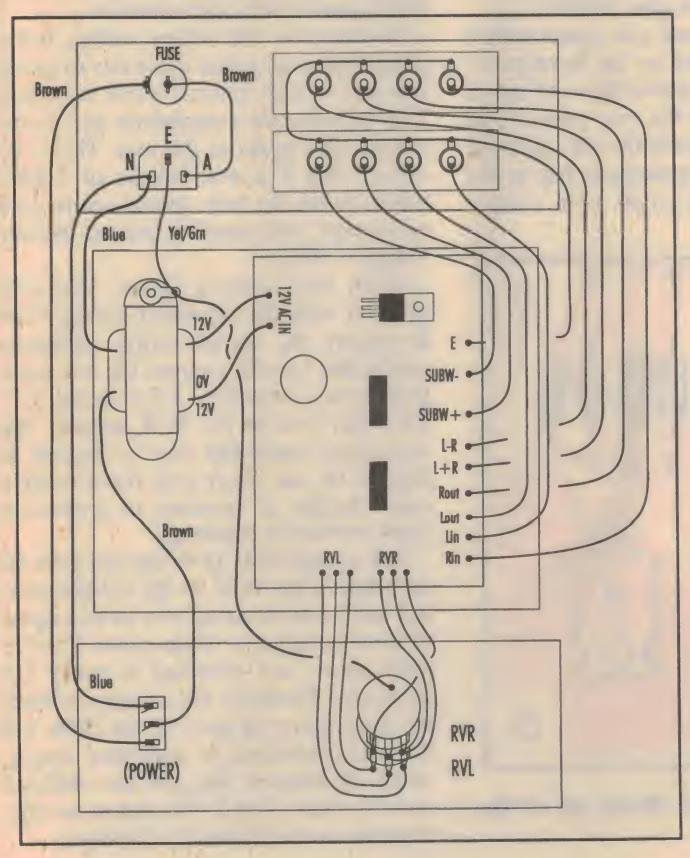
With the PCB assembly completed, the next step is to prepare the metal mounting plate and case panels. The location of the holes in the mounting plate are shown in Fig.3; the outer four holes are used to mount the plate itself in the case, while the remaining holes are used for mounting the transformer and PCB. (Note that the solder lug used to earth the plate assembly is clamped under an additional nut and lockwasher on the rear transformer mounting screw.)



Another close up view inside the case, this time showing the wiring near the front of the PCB and front panel.

As you can see, the front panel of the prototype decoder was 'dressed up' with an adhesive plate of Dynamark photosensitive aluminium, and the artwork for this is reproduced here actual size for those who wish to use it. A photocopy can also be used as a template, for cutting the holes in the front panel itself.

You'll have to work out the location of



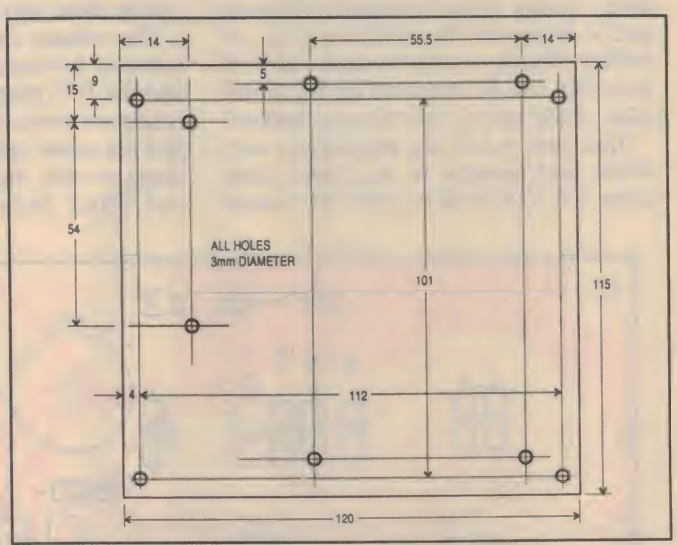
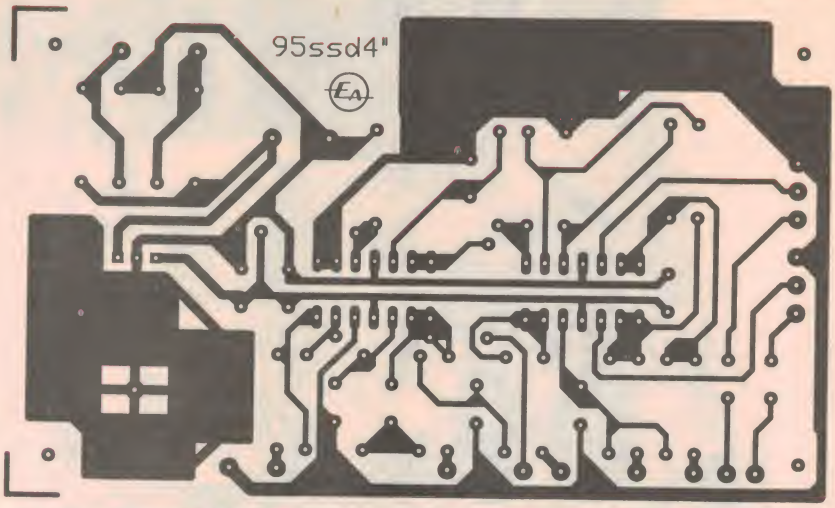


Fig.3 (above): Use this diagram as a guide when you're drilling the holes in the internal mounting and shield plate.

Fig.4 (left): A diagram showing all of the off-board wiring in the decoder. Note that all of the joints for the mains wiring on the left hand side of the diagram should be protected by suitable insulating sleeving, as explained in the text. For clarity, the shield braids of the signal connector leads are not shown; these are soldered at the connector ends only.



Here is the pattern for the decoder PCB, reproduced here actual size as usual for those who wish to etch their own boards.

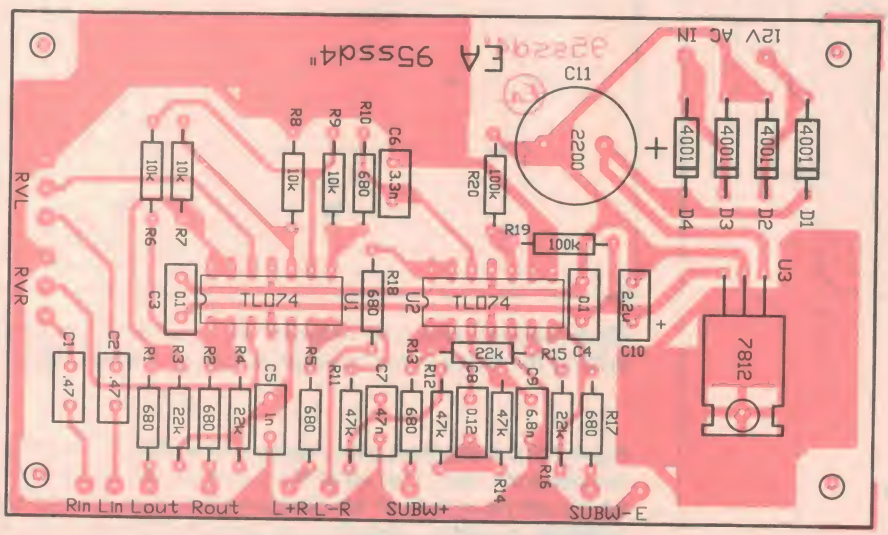
the holes on the rear panel yourself, using the photos as a guide. These are not really critical; the main thing to watch is to keep the signal connectors as far as possible from the mains wiring and power transformer, to minimise hum and maximise safety. I always use the mains connector and fuseholder themselves as 'jigs' when I'm cutting the holes for them, to ensure that I get a snug fit and neat result.

Once you've completed preparing the holes in the shield plate and panels, you're ready for the final stages of assembly. The power transformer and PCB assembly can be mounted on the shield plate, ready to fit it into the case bottom.

Take care to bolt the transformer very firmly and securely to the shield plate, using star lockwashers under the mounting nuts. It's also a good idea to fit the earthing solder lug to the rearmost screw, at this point, after the screw is fully tightened — and using an additional lockwasher and nut.

The PCB assembly should be spaced a few millimetres up from the shield plate using either additional nuts on the mounting screws (the method I used), or by using small spacers. This ensures that the plate doesn't bridge any of the PCB tracks. Then the complete plate assembly can be fitted into the case bottom.

The volume control and mains switch can now be mounted on the front panel, and the IEC plug, fuseholder and signal connector strips on the rear panel. Note that the mains switch is fitted to the front panel so that the uppermost lug is the one which *lacks* a small wire visibly



And here's the board overlay diagram, to guide you in fitting all of the components to the PCB.

connecting to it from within the case. With these components mounted, you can lay the two panels 'face down' at front and rear, and proceed with the remaining wiring. This is shown in simplified form in Fig.4.

I suggest that you do the mains wiring first, taking great care to fit insulating sleeving over each 'live' joint to prevent accidental contact. The *blue* primary wire from the mains transformer connects directly to the 'N' lug of the IEC plug on the rear panel, while a second wire with the same type of blue mains insulation runs from the 'N' lug to the *lowest* lug of the mains switch, on the front panel.

The brown transformer primary wire connects to the *centre* lug of the mains switch, while a second wire with brown mains insulation runs from the *top* switch lug to the *side* lug of the mains fuseholder on the rear panel. The rear axial lug of the fuseholder then connects to the 'A' lug on the IEC plug, again using a short wire with brown mains insulation.

The central 'E' lug of the IEC plug connects directly to the shield plate earth lug, via a short length of wire with green/yellow or green mains insulation. A second length of the same wire is then used to connect the solder lug to the case of the volume control. You may need to scrape the pot case slightly, to ensure that a good solder joint is made.

To complete the mains wiring, use a couple of small nylon cable ties to group the active and neutral wires together, both between the transformer and mains switch, and again at the rear. This is to ensure that if a wire breaks or a joint works loose, the wire should not be able to 'wander' and possibly contact the low voltage wiring.

With this wiring done, you can proceed with the off-board wiring. This is mainly the signal wiring, although you'll also have to connect the two main transformer secondary wires to the 12V AC input pins on the PCB, nearby. The remaining centre-tap wire is unused; it should be cut short and fitted with a small length of sleeving to prevent it from contacting anything.

The connections from the six pins on the front of the PCB to the volume control can be made using two short lengths of three conductor ribbon cable. They're quite short, and shielding is really not necessary. However the wiring between the pins along the side of the PCB and the rear connectors is somewhat longer, and I recommend that you use shielded wire for them. (Fig.2 does not show this, however, in the interests of clarity.)

Note, however, that the shield braids of these wires should NOT be connected at both ends; they should only be connected at their connector ends, and insulated at the other. The 'earth' lugs of the connectors are linked by a length of tinned copper wire, and a single wire used to connect them to the 'signal earth' pin on the PCB. This is all to prevent the formation of internal earth loops.

Fitting these last wires is a bit tedious, but the easiest approach I've found is to cut the eight lengths of light shielded wire to length first, and carefully prepare all of their ends — one with both the shield braid and centre conductor prepared for soldering, and the other with the braid cut short and fitted with an insulating sleeve. Then you can fit the wires one after the other, starting with those for the lower strip of connectors and ending with those for the upper strip.

Testing it

With the wiring completed, the final step before testing is to carefully check everything for errors — especially in the mains wiring, where a mistake could be disastrous. If everything seems in order, you should be ready to apply power and check the power supply voltages. To do this, ready your multimeter or DMM by setting it to a suitable voltage range, with its common lead connected to the earth lug of one of the signal connectors. Then apply power, and quickly use the meter's remaining test lead to measure the voltage at pins 4 and 11 respectively, of either U1 or U2. Pin 4 should measure very close to +6V, while pin 11 should similarly be very close to -6V.

If both voltages measure OK, your decoder is almost certainly working correctly and is ready for final assembly and use. But if the voltages are not right, switch off immediately and look for the cause. Probably the most likely cause is fitting one of the polarised parts the wrong way around, so check especially capacitors C10, C11, the bridge rectifier diodes and the two 14-pin ICs.

Assuming you haven't made any 'blues' and your decoder is working correctly, all that remains is to connect it into your amplifier system and enjoy surround sound. If you're adding the decoder to an existing stereo system, you can feed its inputs from the outputs of the system's preamp or control unit, or alternatively from the Tape outputs of an integrated amp. The decoder's main R and L outputs can then be fed back into your stereo power amp, using the Tape inputs if necessary.

You'll need additional power amplifier channels to handle the additional signals produced by the decoder, and here's where a spare stereo amp or two can be pressed into service. If you don't have any spare amplifiers, an alternative would be to build up one or two of the 'Shoestring Stereo' amplifiers, as described by Rob Evans in the December 1994 issue. At the very least you'll want to use one additional amplifier channel for the R-L 'surround' signal, to feed a speaker at the back of your listening room. Then if you have a second extra channel, this can be used to drive either a 'front centre' speaker with the R+L signal, or a suitable subwoofer speaker with the 'subwoofer plus' signal.

To realise the full potential of the decoder, you'll need at least three additional amplifier channels so that you can feed all three of these speakers. And if you have one more amplifier channel again, this can be driven from the 'subwoofer minus' output, to provide more power for the subwoofer. (Note that the subwoofer speaker is then connected directly between the 'plus' outputs of the two channels, so they work in push-pull.)

One last word: even with this simple decoder, you'll still need to experiment a bit with the gain controls of the various amplifier channels, to get the right balance between the main stereo outputs and the additional surround channels. But once this is done, you can use the decoder's volume pot as your main system volume control.

Despite its simplicity and low cost, the surround sound effects you can achieve with this decoder can be surprisingly good. And with the money you've saved, you can buy more CDs or movies! ❖

PARTS LIST

Resistors

All 1/4W 1% metal film unless specified:

R1,2,5,10,13,17,18	680 ohms
R3,4,15,16	22k
R6,7,8,9	10k
R11,12,14	47k
R19,20	100k
RVl,r	50k dual log pot

Capacitors

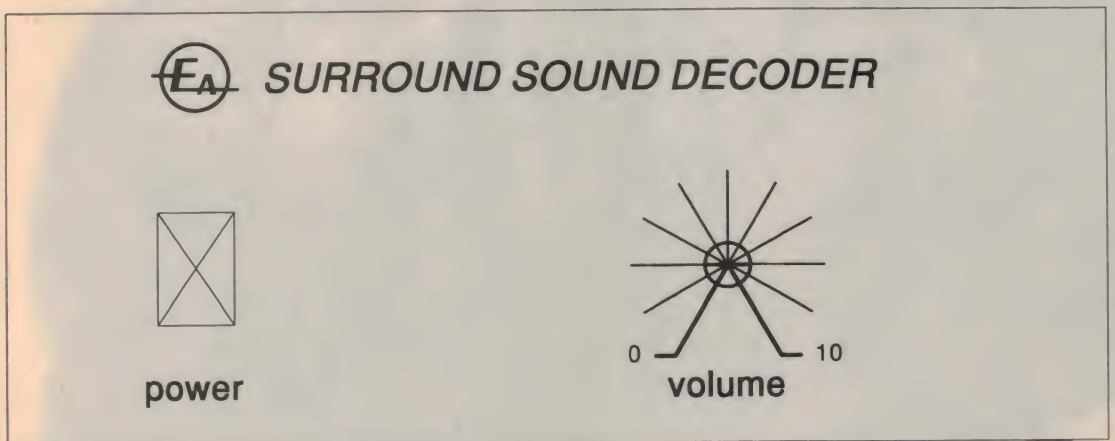
C1,2	0.47uF 63V MKT plastic
C3,4	0.1uF monolithic ceramic
C5	1nF MKT or met. polyester
C6	3.3nF MKT or met. polyester
C7	47nF MKT or met. polyester
C8	0.12uF 100V MKT plastic
C9	6.8nF MKT or met. polyester
C10	2.2uF 16VW tantalum
C11	2200uF 25VW RB electrolytic

Semiconductors

D1-4	1N4001 silicon power diode
U1,2	TL074 quad FET input op-amp
U3	7812 three terminal regulator

Miscellaneous

Plastic box, 160 x 155 x 65mm; PC board, 110 x 66mm, code 95ssd4; power transformer, 240V to 12.6V at 150mA; IEC mains plug, panel mounting; cartridge fuseholder, panel mounting, with 250mA fuse cartridge; two in-line 4 x RCA socket strips; SPST rocker switch, mains rated, with inbuilt neon lamp; control knob; 115 x 120mm piece of 1mm aluminium sheet; six 12mm x 3mm machine screws, with 11 nuts and seven star lockwashers; solder lug; shielded wire for internal signal leads; 3 x nylon cable ties; heatshrink or varnished cambric sleeving, hookup wire, solder, etc.



For those who would like to duplicate the front panel on our prototype, here is the artwork reproduced actual size. It could be used in negative form, if you prefer a dark panel with white lettering.

Follow up to a popular project:

OUR ACS DECODER IN A DIGITOR A-4199

Bob Parker's Improved ACS Decoder design of September 1993 has been deservedly popular, with large numbers built to date. However the radio model used as an example to show how the decoder could be used has now become unavailable. Here's an update, showing how to fit the decoder into the latest Digitor model stocked by Dick Smith Electronics stores.

by BOB PARKER

It's about 18 months since this magazine published details of my 67kHz and 92kHz ACS (Ancillary Communications Service) decoder, and followed it up in the following month with instructions on how to install it in a Dick Smith 'Digitor' A-5235 portable AM/FM stereo radio/cassette player unit.

Since then, quite a few of these radios have been modified for ACS reception and have generally performed well. But now this model has been superseded by a smaller, more refined Digitor unit, the DSE catalog No A-4199. At the same time, there seems to be an increasing number of popular non-English ACS broadcasters appearing on the air.

Consequently yours truly has been given the honour of figuring out how to fit the ACS decoder to this new model, and of sharing this information with my fellow *EA* readers...

If you're not familiar with ACS or the 'Improved ACS Decoder' design upon which this article is based, I suggest you consult the original description in the September 1993 issue before proceeding.

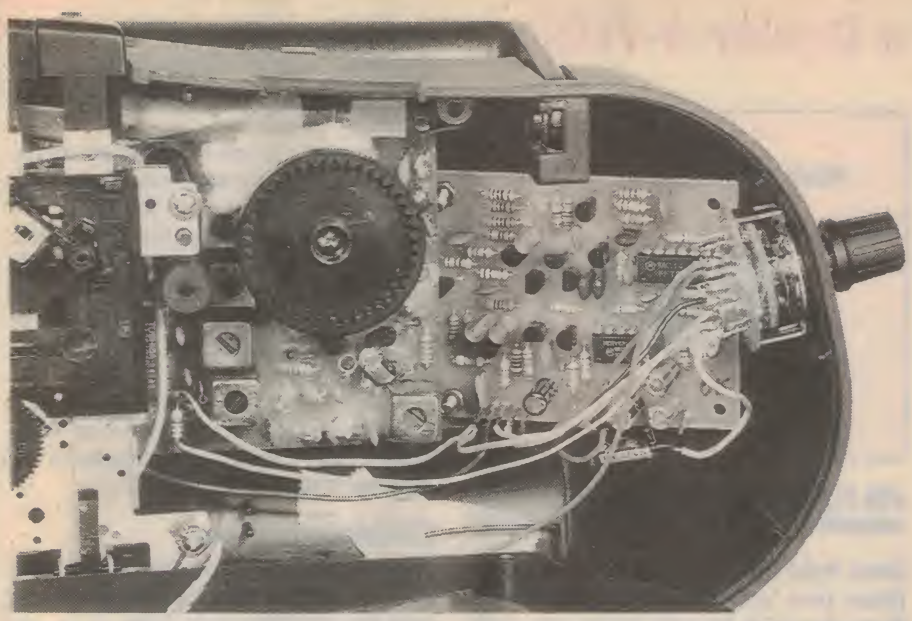
Disassembly

The very first thing to do is unplug the AC power lead from its rear socket, remove any batteries, and leave the battery cover off. Now turn the tuning knob as far to the **right** as it will easily go, and mentally note the position of the dial pointer — on the unit I modified, it was in line with the '8' of the '108' (MHz) on the FM scale. This is necessary for correctly realigning the tuning capacitor linkage, during reassembly.

Next, use your faithful No.2 or similar Phillips screwdriver to remove the seven case retaining screws, which live at the bottom of the 'wells' in the unit's rear panel.

Don't forget the one in the centre of the battery compartment — but don't touch the screws on the carrying handle. Save the screws in a safe place, to curb their migratory tendencies; a plastic take-away food container is ideal. (Especially if it's empty and washed!)

Place the unit on its back on a soft surface, open the cassette door by pressing the 'STOP/EJ' button, then gently lift the whole front casing clear, and place it face-down on the soft surface. You might have to pull the electret microphone out from its hole, if its connecting lead is a bit short.



A view inside the Digitor case, showing how the decoder board and switch are mounted in the right hand end. Only two screws are used to attach the board. Also visible is some of the wiring to the radio's own main board.

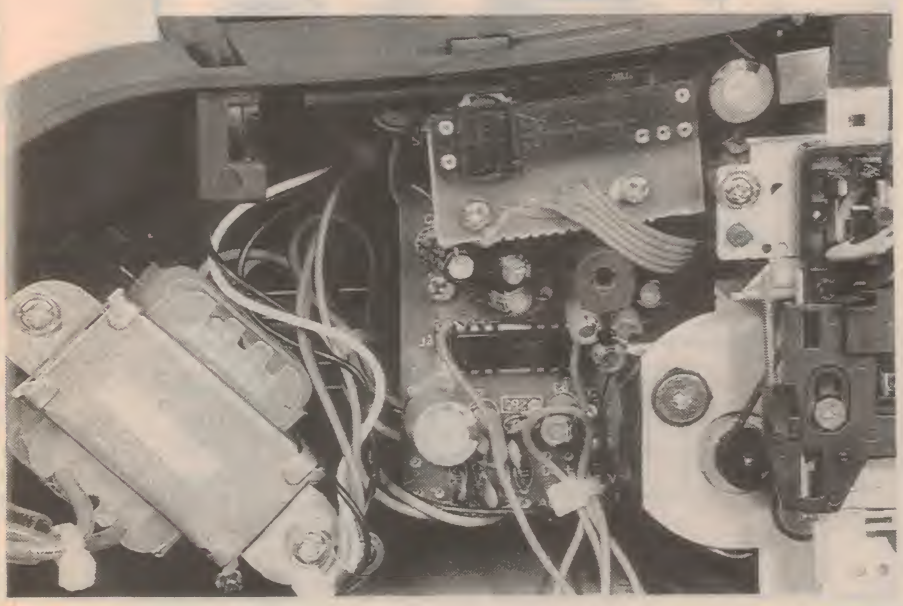
Mounting holes

Consulting the photos, familiarise yourself with the area where the ACS board and its rotary switch is going to be installed. Then temporarily refit the front of the case to the rear (without screws), and place the unit face down. Using Fig.1 as a guide, carefully mark a point 18mm to the right of the extreme left-hand edge of the ventilation grille, and 10mm down from its lower edge. Then using your ACS board as a template — or a ruler — mark another point 46mm directly up from this first one, and make indentations in the soft plastic (with a nail or similar) at both points.

Now, with great care, drill the ACS board mounting holes. If possible, use a hand drill or at least a *slow* power one. First use a small, say 3/32", drill to make the guide holes, **inclined at about 20° from vertical, aiming towards the centre of the unit.**

Withdraw the drill the moment it is fully through the plastic, otherwise you'll probably drill a hole in the main printed circuit board as well!

Next, use a 1/8" (3mm) drill at the same angle to enlarge the holes to their final size. If you like, you can 'sculpt' out the left-hand sides of the mounting holes so the screw heads will sit almost flat. A small 'Stanley' type of knife works well, but be careful not to slip or to remove too much plastic!



This second view inside the case is taken at the left hand end, and shows the power take off wire connecting to pin-12 of the stereo power amp IC.

Switch hole

Once again, separate the front of the unit from the back, leaving the back standing vertically this time. Study the photo showing where the rotary switch mounts, then make a small mark on the front edge of the case, 17mm up from the centre reinforcing 'rib'. Now make another indentation, 15mm towards the back of the case from this mark.

Drill a small guide hole then a 1/4" one at this point, then carefully ream the hole out to the correct size for the switch mounting bush. Do this operation SLOWLY, because it's very easy to make the hole too big!

Now firmly grasp the front and rear case sections, and thoroughly shake and/or blow out all the little bits of plastic, which will otherwise seek out and jam up the cassette mechanism at a later date...

At this point, while your hands are still dirty, I suggest you use a fine-toothed hacksaw and then a file to remove about 5mm from the end of the switch shaft, if it's a DSE catalog number P-7504. This will allow the knob, when fitted, to sit neatly close to the case surface. Now use a pair of pliers to break off the switch's anti-rotation lug, which you won't need.

Board pre-wiring

The next step is to attach appropriate lengths of thin hookup wire to the required ACS board pins, since there's insufficient room for soldering them when the board is mounted in its final home. I suggest the use of appropriately coloured wires (e.g., red for positive supply, black for ground, etc), to minimize the possibility of connection errors...

Since all signal carrying leads are quite short, I've dispensed with the use of audio coaxial cable in this new ACS modification.

Working from left to right, and cross-checking with the circuit diagram and photos, solder the following lengths to the ACS board pins:

Input: 2 x 100mm
First Ground: 110mm
Hi: 90mm
Lo: 80mm
Second Ground: 85mm
Third Ground: No connection (except 0.1uF disc bypass capacitor)
V+: 85mm (and other end of bypass capacitor)

Our ACS Decoder in a Digitor A-4199

Out: 1uF 50V capacitor to (-) lead; 75mm wire to (+) lead (see photo)
Fourth Ground: No connection.

Mounting the board

The following installation method may seem a bit 'rough', but unfortunately the casing of this unit is a mass of curves. Space is also quite limited, and I was unable to find a better way of mounting the board in the space available...

Once again consulting the photos, use a pair of 3mm screws, 12 or 15mm long, plus matching nuts, to mount the ACS board in the position shown. Only tighten the screws up just enough to stop the board from rattling around, or there's a high risk of damaging it!

A drop of nail polish or similar between the nuts and screw threads should help to keep the nuts from unscrewing.

Installing the switch

Now install the rotary switch, with its orientation as shown in Jim Rowe's beautiful photos, and with one washer between its body and the case. Tighten its mounting nut with a suitable spanner, shifter or bullnose pliers. Take care not to slip and scratch the case!

At this point you can start wiring the switch, beginning with the three wire links which can be fabricated from component lead offcuts. Then untangle the relevant leads from the ACS board, and solder them to their respective switch pins, as shown in the circuit diagram.

It's easier to complete the ACS modifications with the cassette mechanism out of the way, and this is quite easily achieved. Note where the thin shielded lead from the tape head goes, then remove the mechanism's four corner mounting screws and save them in your container. Gently grip the mechanism between the control buttons and its lower edge, lift it clear of its plastic 'pillars', and unclip the leaf switch wires from the bent-over lug beneath it.

Now you're free to put the cassette deck down, about 100mm to the left of its normal position, while you do some serious wiring and soldering.

Wiring mods

First locate wire link 'J20' on the main PCB; it runs from the bottom right-hand corner of the TA7640AP IC (though this may have a different type number) to almost the lower PCB edge. Now cut the link in the centre, and bend the two 'stumps' straight upwards. Cut the leads of a 47k resistor down to about 5mm long, then solder it between these two 'stumps'. Solder the wire from the ACS board's Input pin (and which continues to the switch) to the end of the 47k resistor closest to the TA7640AP. Then fit a 130mm length of hookup wire between the resistor's other end and the appropriate switch pin, as shown on the circuit.

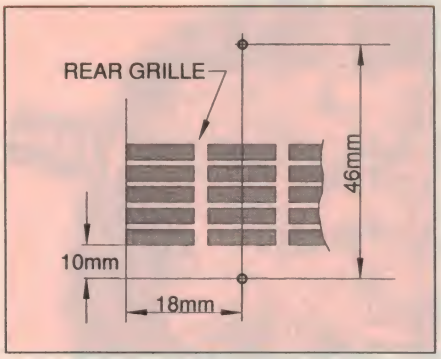


Fig.1: Showing the location of the PCB mounting holes in the rear of the case.

Next, locate link 'J11', which runs parallel to the lower PCB edge, from the TA7640AP's bottom left-hand corner. Don't cut J11, but solder the free end of the wire from the ACS board's first ground pin to the right-hand end of J11.

Now you can return the cassette mechanism to its normal position, but first ensure the record/play switch linkage (the moulded plastic thing sitting on the pillar in the centre of the PCB) is fully clockwise, with its lowermost lug sitting against the long, thin record/play switch's actuating 'snout'.

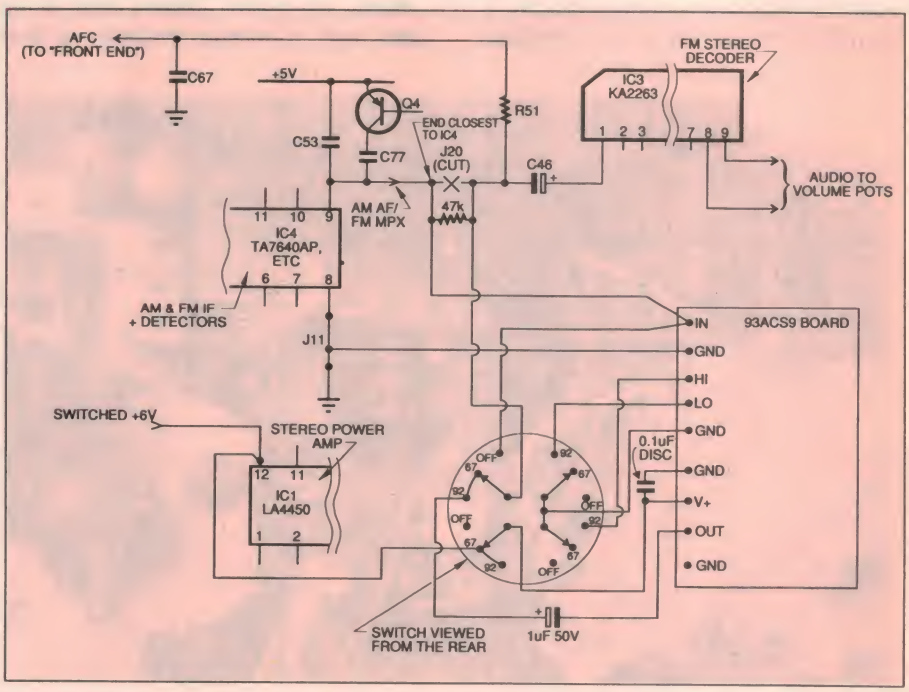
Now pick the mechanism up again, replace the leaf switch leads under their bent lug, correctly route the tape head cable, and sit the mechanism back where it originally was. (You may have to hold the record/play switch linkage against the switch while you do this.) Replace the mechanism mounting screws and GENTLY tighten them.

(I hope none of this has made anyone feel they'd like to be a service technician? Take it from me, the money's terrible and it sends your hair grey!)

Obtaining power

Finally the last electrical connection: obtain a 350mm length of hookup wire, strip one end back only 2mm or so, and tin it. If the insulation shrinks back, trim the conductor so only about 2mm is showing. Now turn your attention to the end of the main PCB next to the power transformer; locate the LA4550 power amplifier IC and pin 12 at its top left-hand corner.

Use a small screwdriver or file to scrape this pin clean of any locking goo which may have been applied to the nearby mounting screw. Then quickly tin it with a reasonably hot soldering iron, and solder the prepared wire end to it. Carefully check that you haven't accidentally made a solder bridge to the adjacent pin 11, then connect the other



Details of the modifications necessary in order to fit the author's ACS decoder into the new Digitor A-4199 radio.

end of the wire to its switch contact, as shown in the circuit.

Testing

This completes the installation of the ACS decoder board, but before testing it, thoroughly recheck your work against the photos and circuit diagram. When you're happy that everything's OK, stand the rear section upright again, turn the rotary switch fully anticlockwise, extend the antenna and apply power.

Make sure the AM/FM radio still works normally, tuning by turning the circular tuning capacitor linkage, and if not, find and correct the problem.

Then turn VR1 on the ACS board to mid-travel, and the radio's band switch to 'FM'. Turn the rotary switch to the centre 67kHz position, adjust the volume control for a moderately loud 'roar', then turn the tuning capacitor linkage slowly from end to end and listen for ACS transmissions on 67kHz; if necessary, repeat the procedure for 92kHz.

When you find a signal, tweak VR1 for the same volume on both ACS and normal FM signals.

If you have any problems, please consult the first ACS article in the September 1993 issue, where I've suggested some general fault finding checks.

Reassembly

You need to do one or two things before you return the Digitor to its former glory...

First, gently turn the tuning capacitor linkage fully clockwise, and make sure the dial pointer is in the position you memorised at the beginning. Next, if you had to pull the electret microphone out of its recess, now's the time to push it back into place. Make sure too that all wiring is clear of the cassette mechanism and the case edge.

Align the front of the unit with the rear, then gently push them together; you'll almost certainly have to wiggle the tuning knob to get the linkage to engage, and you might have to re-separate the halves slightly and turn the knob a bit, to obtain the original scale-end pointer position.

Close the cassette compartment door, then replace and gently tighten the seven rear-case mounting screws.

Now you need to designate the 'OFF/67kHz/92kHz' rotary switch suitably. I used white rub-down dry transfers (DSE catalog number N-5750), with a careful light coat of 'Humbrol' enamel (from a hobby shop).

Finally, fit a suitable knob to the switch shaft (DSE catalog number P-7010 in the photos), and start listening to your favourite ACS transmissions. If you've used other ACS-modified FM receivers before, you may get a pleasant surprise from the performance of the Digitor A-4199. It sounds *very* good...

And remember, most if not all ACS program material is COPYRIGHT. Do NOT record the signals, or feed them into a public address or telephone music-on-hold system etc, without the broadcaster's authorisation.

How it works...

This article wouldn't be complete without a brief explanation of how the modified Digitor circuit works, for anyone who's interested or needs to do fault-finding.

First I should explain that the A-4199's main PCB is fairly hard to remove and replace, fraught with the risk of breaking and damaging things. So the circuit is slightly more complex than it really needs to be, to allow connections to only the component side of the PCB.

IC4 is the Digitor's common IF amplifier and detector IC for both AM and FM radio reception. The AM audio or FM multiplex signals appear from its pin 9, depending on the receiver's mode. Also present on pin 9 is a DC voltage which in the FM mode is tuning dependent, providing an automatic frequency control (AFC) error signal for the FM local oscillator, via the low-pass filter formed by R51 and C67.

Under normal conditions the AM audio or FM multiplex signal feeds straight into the FM stereo decoder IC3. If this IC sees little or no 19kHz 'pilot tone' signal, as with an AM or weak FM signal, it switches to 'mono' mode and simply feeds its input signal straight out to both its left and right output pins. This is the mode we are interested in, because it simplifies switching between normal and ACS operation.

So... with the ACS switch at 'off', the radio operates exactly as it did before, since the ACS board's input pin imposes almost no loading on IC4's output.

With the switch at '67kHz' or '92kHz' however, the ACS board receives the maximum available power supply voltage from IC1's positive supply pin (12), and demodulates any ACS signal present on IC4 pin 9. The AC output impedance of the ACS board is very low, and this, combined with the 47k resistor, means that negligible demodulated FM signal is present at the negative end of C46 — only lots of ACS audio from the decoder board.

The 1uF 50V capacitor prevents the ACS board from disturbing the DC voltage from IC4 pin 9, allowing normal AFC operation in the ACS mode. ❖

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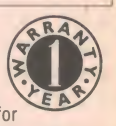
GME Kingray UHF/VHF Mast Head Amplifier

MODEL - MHW306
THERE ARE MANY MAST HEAD AMPLIFIERS ON THE MARKET, AND WE BELIEVE THAT THIS IS THE "**BEST ONE**". Most TV antenna installers would fit a GME Kingray amp for ease of installation and for a long trouble free service life. The amp uses surface mount technology and is housed in a UV resistant, waterproof plastic case.
The MHW306 is an ultra wide band, low noise mast head amplifier for the UHF and VHF television bands and is specifically designed to allow either a combined VHF/UHF antenna or separate UHF and VHF aerials to be used. Adjustable VHF gain - tilt control. The unit amplifies VHF signals by 20dB maximum variable down to 10dB on low band and 15dB on high band. The UHF gain is fixed at 30dB.



The power supply is short circuit proof, allowing a short circuit to be tolerated for an indefinate period without harming the unit. Removal of the short circuit will immediately allow the power supply to operate normally. Comes complete with comprehensive instructions.

Cat. LT-3290 **AUSTRALIAN MADE** **$109.00**

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"THERE ARE THOUSANDS OF THESE DETECTORS PROTECTING PROPERTY ALL AROUND AUSTRALIA" Many alarm installers are using Bellmate PIR's in their commercial installations. They wouldn't be using Bellmate if they weren't ultra reliable. For full specs see our 1995 cat.
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NEW These speakers are ideal for computers and are supplied with brackets to mount them on the side. The colour is fawn, so they match most computers. They have a built in booster amplifier which delivers about 2 watts per channel.They are magnetically shielded, so they won't effect the monitor. There is a volume control and a bass booster button. They run from either 4 x AA batteries (not supplied) or use a 500mA 6 volt mains plug pack. Cat MP3012 $23.95. Dimensions: 134(H) x 88(D) x 85(W)mm. Freq Resp 50Hz-15,kHz.
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WE HAVE TO CLEAR THIS MODEL TO MAKE WAY FOR THE NEW MODEL!!! You won't believe the features you get for such little money! CHECK THIS OUT
The Jaycar digital multimeter features: •frequency •transistor tester •capacitance •auto power off •large display •audible continuity •diode test •20 amp capability •AC/DC voltage •resistance •low battery warning and is housed in a yellow high impact case. Comes complete with tilting bail, quality leads, instructions and a 12 month warranty. Be quick limited stocks available
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Great Value $34.95

NEW KITS

Economy Surround Sound Decoder Kit

NEW

REF: EA 5/95

This surround decoder uses low distortion analogue circuitry to produce a surround channel, centre channel and subwoofer output channel. If our genuine Dolby Pro-Logic decoder (KC5175) is out of your price range, then this economy decoder is worth considering. The Jaycar kit is 100% complete with case, PCB, punched and silkscreened front panel, punched rear panel, transformer, RCA sockets plus all electronic components as per the EA article.

Cat. KA-1773 **$59.50**

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NEW

REF: EA 4/95

This kit will provide both a 455kHz signal for aligning AM radio IF strips and a 10.7MHz signal for doing the same job on FM radios. Both signals are modulated with an audio tone of around 1kHz, with the 1kHz audio signal available by itself for audio testing. The Jaycar kit is complete with PCB, case, silk screened front panel, plus all electronic components. Three AA penlight batteries required. Use Cat. SB-2354 Pk4

Cat. KA-1796 **$23.95**

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REF: EA 4/95

This project allows you to use your CRO more effectively with digital circuits by allowing you to monitor any given event in the circuit under test, and to trigger the scope only when all the relevant input conditions are met. With eight inputs (expandable to 24), it also includes an adjustable trigger delay, so it can effectively convert your scope into a low cost logic analyser. Kit is complete with PCB, case, screen printed front panel, IC test clips plus all electronic components.

NEW

Cat. KA-1772 **$55.00**

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NEW

REF: ELECTRONICS AUST APRIL / MAY 1995

Cat. KA-1770

$399

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Dolby Pro Logic Surround Sound Kit

DOLBY SURROUND PRO • LOGIC

REF: SILICON CHIP DEC 94 / JAN 95

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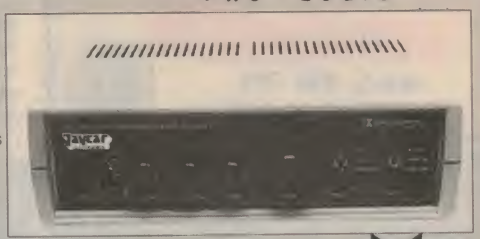
This kit is supplied with pre-tinned PCB, Dolby ICs and all electronic components as per the Silicon Chip article, RCA socket bank, potentiometers, switches and internal audio and mains cable. The short form version of the kit is ideal for those constructors who wish to build a complete decoder with amplifier modules in the same case as the decoder. **EXCLUSIVE TO JAYCAR.**



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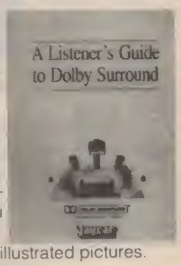
A Listeners Guide To Dolby Surround Book

NEW



If you are planning a home theatre for your home, then this guide is essential. It covers all aspects of what you need to set up, and get the most out of a home theatre system. Topics covered: •Speaker placement •Subwoofers •Surround and centre channel speakers •Power amplifiers •Enhancements for movie viewing - plus much more! This book will answer virtually any question you may have regarding Pro Logic Surround Sound. Don't be left behind - the home theatre revolution is here! 11 pages with fully illustrated pictures. Size: 210mm x 295mm.

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These mini speakers sound fabulous. They have a 3.5" woofer and 2" soft dome tweeter in a bass reflex enclosure, which is made from ABS plastic. They are supplied with steel mounting brackets and have a black metal grill over the speakers. They are ideal for bookshelf speakers, extension speakers for TV and most importantly are ideal for Dolby Surround rear speakers. 4 ohm impedance. Ideal for home or car sound.

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•Frequency response 3.8 - 28kHz ±3dB •Maximum input 35V rms (100W amp power)•No crossover required. •Dim: A 85mm, B100mm ,C 76mm.

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DESIGNED IN THE UNITED KINGDOM. With this brand new PIR, we are able to bring you the very latest in PIR technology at a price far less than others dream about!

NEW

The advanced pulse count feature is not simply one, two or three pulses to trigger, but a various count. It waits for a number of pulses before triggering. The number of pulses depends on the size of each pulse, and the time between the pulses. You simply set the adjuster to maximum, and then, and only then, if you are experiencing false alarms, adjust the unit down.

The Jaytech PIR is manufactured with SMT (Surface Mount Technology) components by machine. SMT reduces the cost of manufacture, so we can sell for far less. Other features include very small size: 53(H) x 65(W) x 47(D)mm, shielded relay and availability of different lenses. Supplied with easy to understand instructions. Standard volumetric lens & mounting bracket supplied with the unit. For full specs see our 1995 catalogue.

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These are for halls or longer narrower rooms. The range is a massive 24 metres and the field of view is 90 degrees.
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This small unit will chime"Ding Dong" when anybody walks past it. It's ideal for placing near a door of a shop or office to advise when someone enters. It can either sit on a shelf or be wall mountable. Sensing distance is 5 metres (indoors under normal light) and operates on 2 x "C" size batteries (not included) which lasts up to one year!!!

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•12VAC 500mA. Terminates to a 3.5mm DC removable plug **Cat. MP-3020**	**$16.95**
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*PLEASE NOTE: Where it states seven reversable plugs, the plugs supplied are: 2.5mm mini plug, 3.5mm mini plug. DC types: ID dia 1.3mm/OD dia 3.5mm, ID dia 1.5mm/OD dia 5.0mm, ID dia 2.1mm/OD dia 5.0mm, ID dia 2.5mm/OD dia 5.0mm, ID dia 2.1mm/OD dia 5.5mm.

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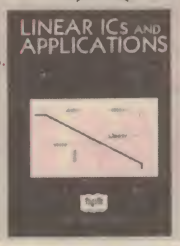
Each chapter of the book ends with a section summarising the covered material in questions and design examples.
220 pages - 175 x 235mm



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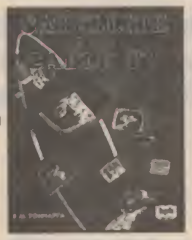
Satellite & Cable TV



Satellite and cable TV have aroused great interest in the Australian TV viewer. Cable TV operations have multiplied many fold and are fast making in-roads into the rural areas. This rapid growth in cable TV (CTV) operations has resulted in a number of manufacturers taking up production/supply of equipment for reception of satellite TV broadcasts/setup CTV networks.
This book is aimed at catering to those interested in understanding the whys and whatfores of satellite and cable TV technology. This venture may also be of use to persons embarking on a career in communications, electronics, satellite communications or cable TV operations.

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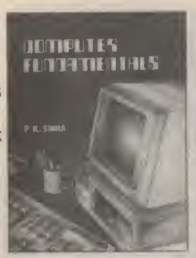

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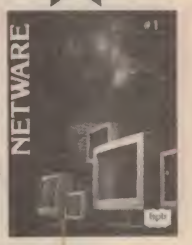

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Construction project:

PLAYMASTER 300W SUBWOOFER AMP - 2

Here's the second and final article describing our new subwoofer amplifier, with its impressive power capability of 320W into a four ohm load or 200W into an eight ohm load, and a built in two-way active crossover with selectable cutoff frequencies. In this article the author describes its construction in detail, and also explains how it's set up.

by ROB EVANS

As you can see from the photos of the prototype, the subwoofer amp is housed in a metal case based around a single deep-finned heatsink, in a broadly similar manner to the Pro Series Three amplifier. The case matches the external dimensions of the previous design, despite the use here of only one power amp module (installed at the rear) and power supply components, so there's quite a bit of fresh air inside. You can also see that the crossover board mounts onto the front panel in quite a simple manner, and its own power transformer has been installed in the front right hand corner of the box, near the main toroidal unit.

We've taken some effort to ensure that this new design is quite simple to construct, through the use of a simple clamping scheme to attach the power amp module to the heatsink, plus minimal interwiring between connectors and circuit boards, and a redesigned crossover PCB that now supports all of the unit's indicator LEDs. The crossover board itself is supported by just the two front panel controls.

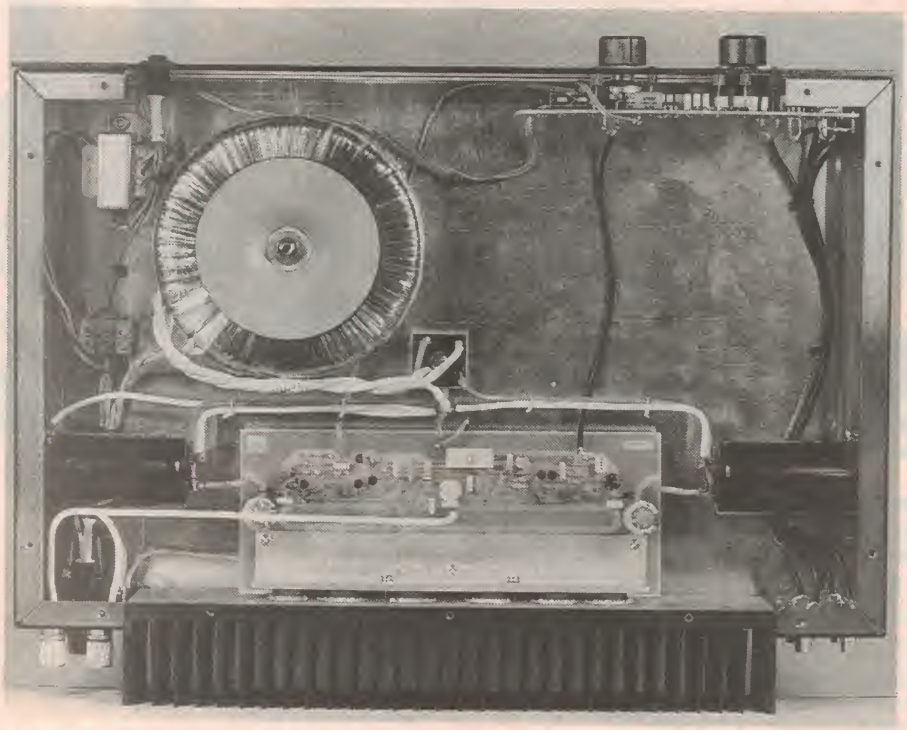
The subwoofer amp's construction can be broadly divided into two main tasks: assembling the amp module/heatsink and crossover assemblies, then completing the box and its associated wiring. To make this task as simple as possible, we've also included several diagrams for you to refer to during the assembly process — including of course, the usual component overlay diagrams.

By the way, it's best to follow the assembly order as described below, since some components are much easier to fit in the latter stages of construction. And for reference, the parts for the crossover fit onto a single PCB coded 95flt3 which measures 155 x 63mm, while the amp module board is coded 95swa4 and measures 202 x 78mm.

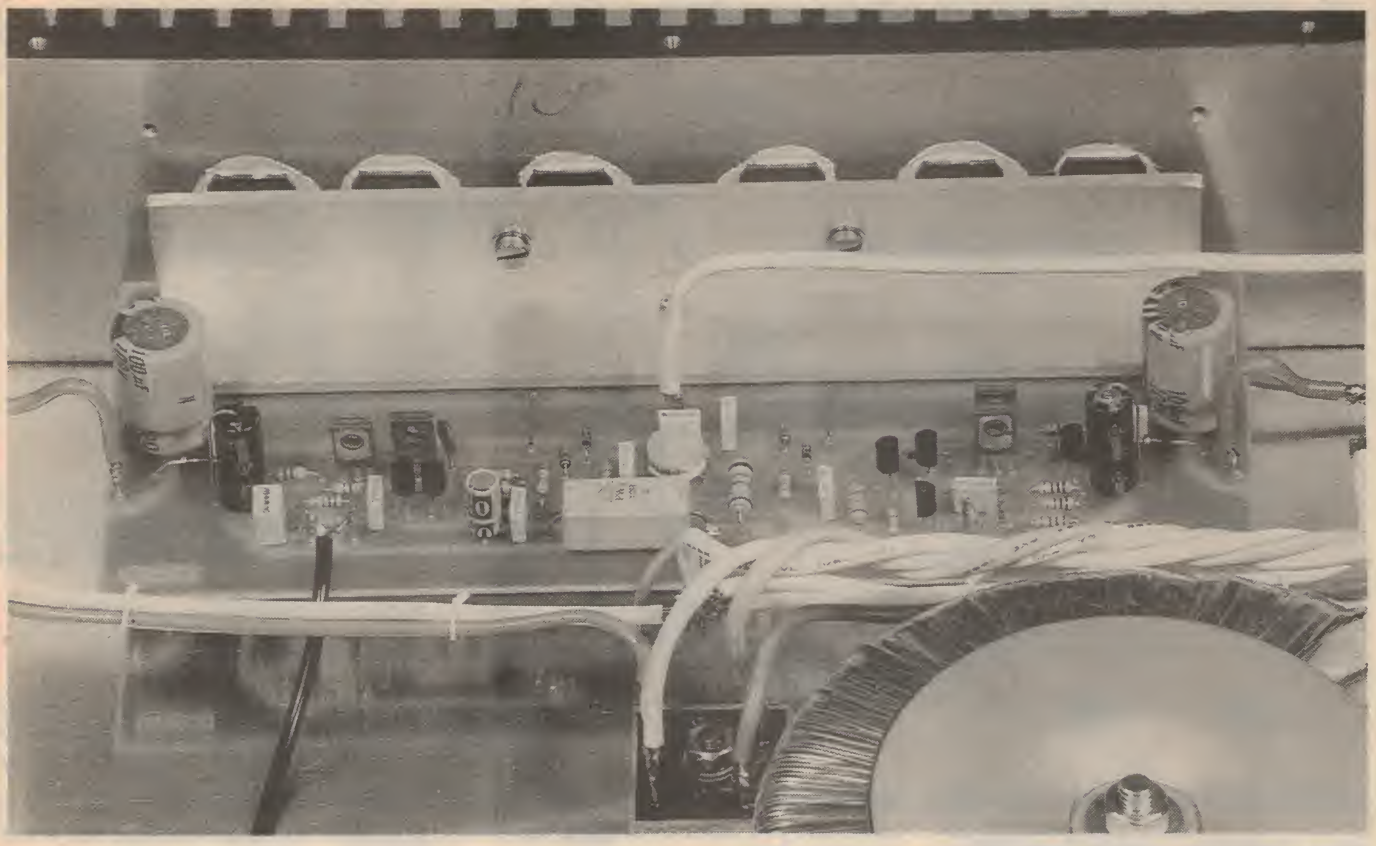
Commence the construction by assembling the crossover board as shown in the component overlay, working your way through from the lower profile parts (links, resistors) to the larger components such as the electrolytic capacitors, and finally the rotary switch. Don't fit the potentiometer or LEDs at this stage, as they will need to aligned to the front panel as the crossover assembly is installed in the box.

Note that there are four wire links on the board, that capacitors C19 to C22 are lying on their side (you will need to crank the leads over to suit), and also that PCB pins for the external connections have been fitted to the *copper* side of the PCB. Take particular care with the positioning of the polarised components such as the electrolytic caps and semiconductors, as their orientation on the board does not follow a regular pattern, and you might like to double check the values of the 1% resistors with a multimeter, since their markings can often be rather difficult to read by eye.

Next, assemble the power amp module by following the same basic procedure



There's plenty of room inside the case, thanks to the compact nature of the amp and crossover boards, and the small amount of wiring used to connect it all together.



Despite the impressive power output, the new amplifier module is surprisingly small in size. As you can see, it uses a simple aluminium bracket to both support the PCB and clamp the power MOSFETs to the heatsink.

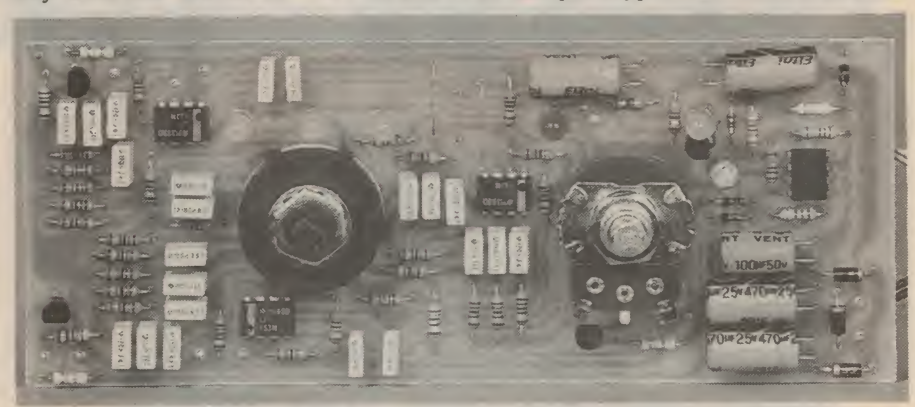
as above. In this case however, there are two links on the board and the PCB pins mount on the component side of the PCB in the normal way. Start by installing the parts as shown in the *component side* overlay diagram, then fit the power MOSFETs, and finally the components on the *copper side* of the board.

As usual, take particular care with the orientation of the semiconductors and the electrolytic capacitors, while referring to the overlay diagrams at all times. As previously mentioned, the four T0-126 driver transistors are no longer bolted to the aluminium bracket as was the case with the Pro Series Three modules, and can therefore be installed at this stage — take careful note of their orientation however. Also note that while we haven't bothered with our prototype, the two BC556 transistors used in the input stage (Q3 and Q4) can be matched in characteristics and thermally bonded together as detailed in the second installment of the Pro Series Three article (March 1994). This provides a small, but arguably audible, improvement in the amp's performance.

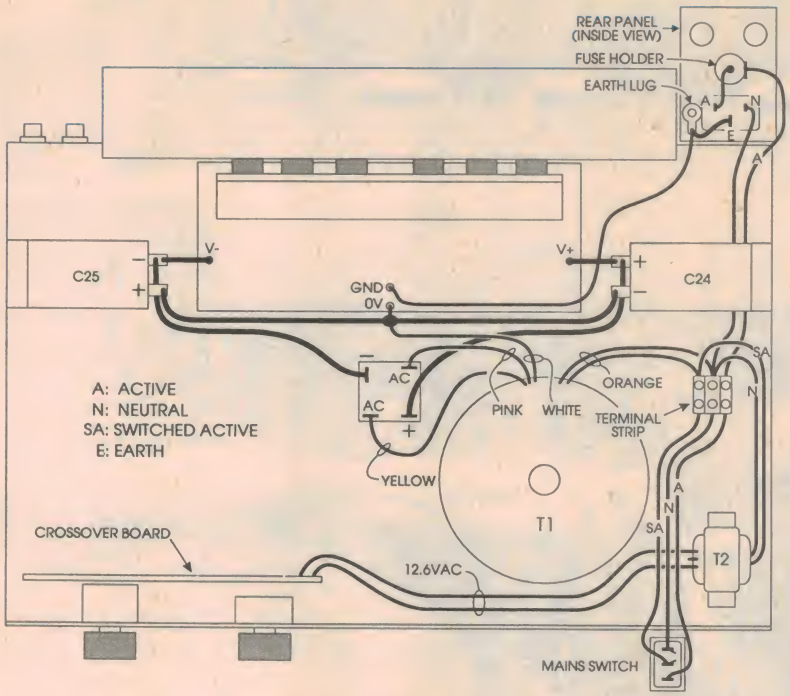
Now bolt the aluminium bracket (measuring 180 x 25 x 25mm) to the PCB using three screws, and install the six MOSFETs while using the bracket as an alignment guide. Note that the two outermost screws should have fibre (or plastic) insulating washers under the nut, so they cannot make electrical contact with the PCB tracks. Once you are happy with the MOSFET positioning, solder their legs in place and then check the location of the bracket. This should be positioned so that the MOSFETs will be evenly clamped to the heatsink surface when the two mounting bolts are installed.

The copper side parts can now be soldered in place, as shown in the matching overlay diagram, while working your way from one side to the other so that there is always access for the soldering iron barrel. All of the resistors (5W and 0.25W types) will need their leads shaped so that their bodies are slightly elevated above the board's surface and the leads cannot come into contact with any nearby (or spanned) tracks, and both the MKT and ceramic eapacitors will need their legs splayed in the same way. Make sure that you don't overheat the latter components, by the way.

After that, the completed amplifier module can be bolted to the heatsink as shown in Fig.1 and the associated photos of the prototype. First, check that the



The crossover board mounts directly into the amplifier's front panel, and is supported by the rotary switch and level pot. Note how the larger electrolytics are mounted horizontally, for additional clearance.



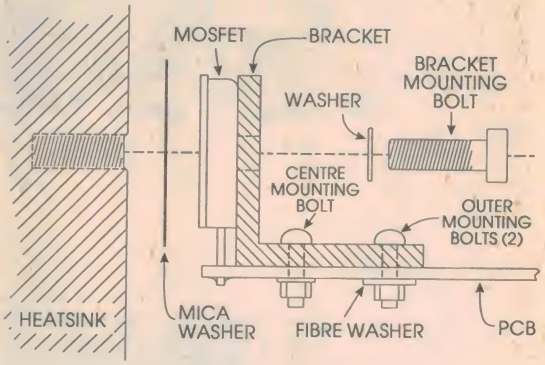
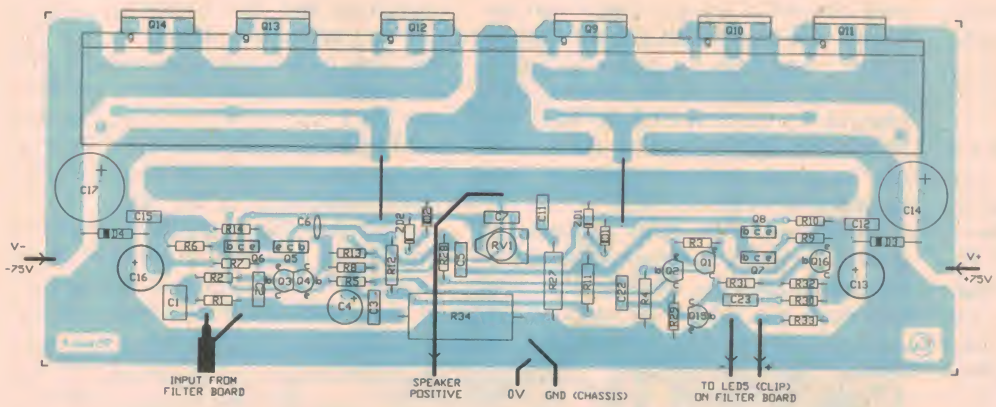


Fig.1 (above): Use this diagram as a guide to fitting both the MOSFETs and aluminium bracket, and when clamping the amp module to the heatsink.

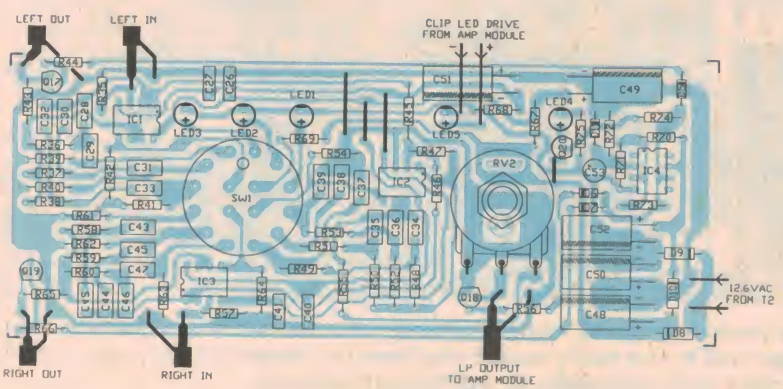
Fig.2 (left): The amplifier's main power connections. Take particular care with the 240V mains wiring, and note that the diagram's heavier

heatsink surface is free from any sharp protrusions, as these may penetrate the mica insulating washers and cause a short. Then coat both sides of the washers with a generous layer of thermal grease and clamp the assembly in place. Check that each washer remains aligned to the MOSFET's metal surface during this procedure, and make sure that you don't overtighten the two mounting bolts.

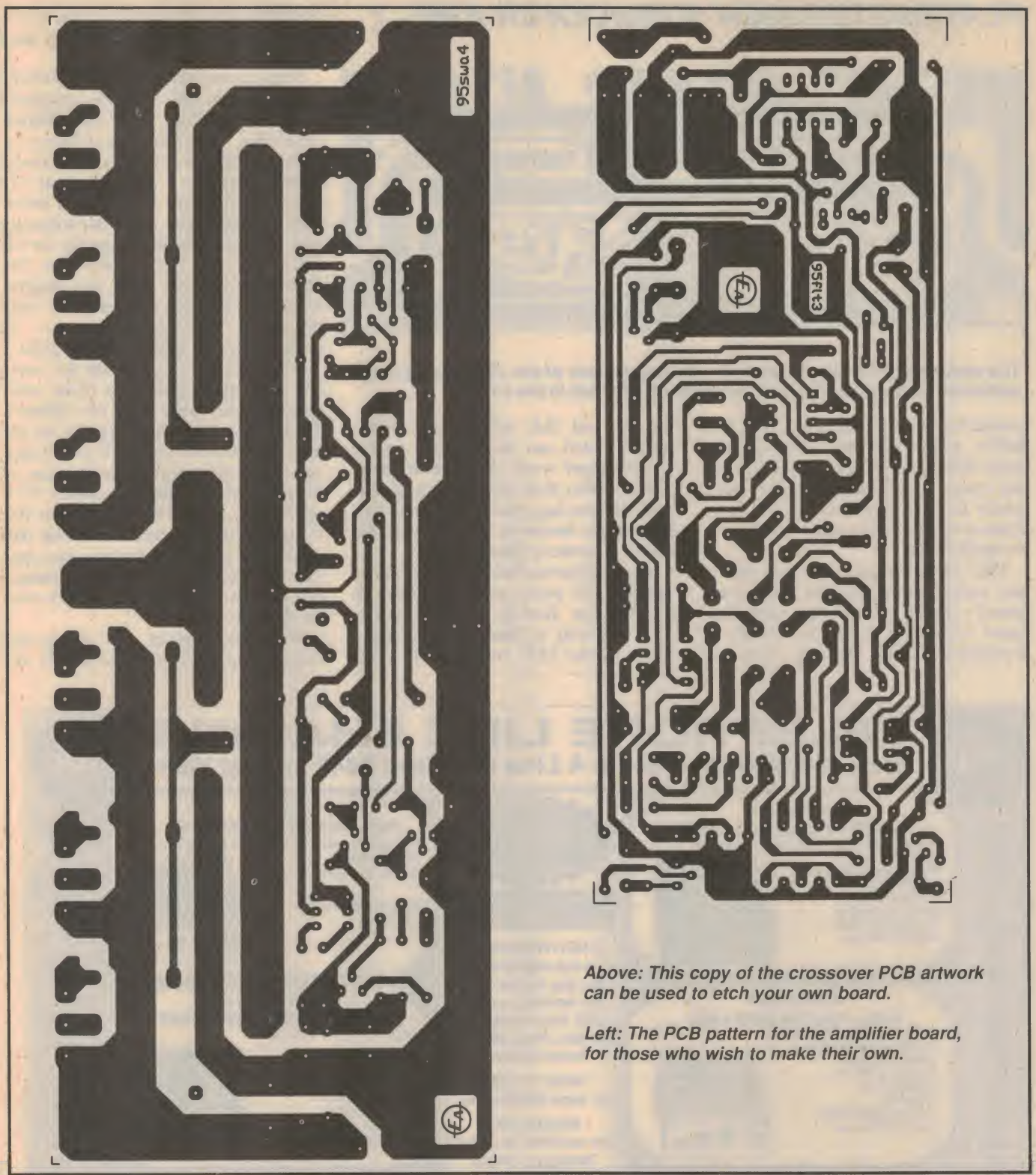
The subwoofer amp's case can now be assembled around the completed amplifier/heatsink module, and the various plugs, sockets and connectors installed — but leave out the 8000uF filter capacitors for the moment. Don't forget to include the main earthing lug under the IEC socket's left hand mounting screw (with a lock or 'star' washer), and make sure that the four RCA input sockets are electrically isolated from the chassis — we used plastic inserts and fibre washers for this purpose.



The overlay diagram for the component side of the amplifier PCB. Carefully follow this layout when assembling the amp module.



The component overlay and wiring diagram for the crossover module. When assembling the unit, take particular care with the orientation of the semiconductors and electrolytic capacitors.



Above: This copy of the crossover PCB artwork can be used to etch your own board.

Left: The PCB pattern for the amplifier board, for those who wish to make their own.

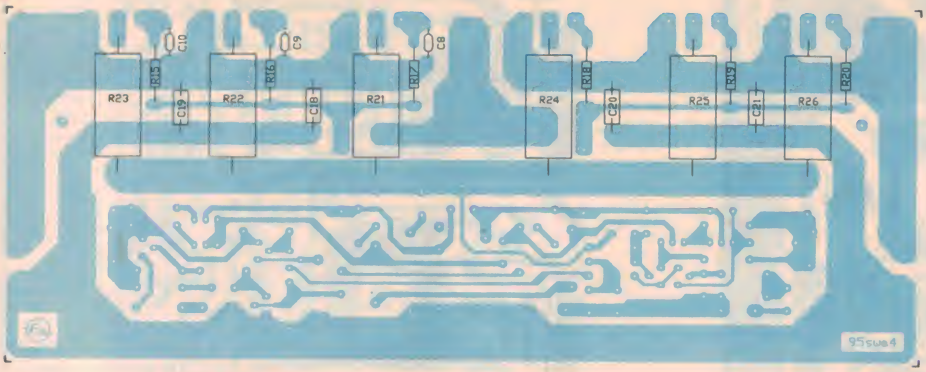
Once the front and bottom panels have been screwed to the side panels, the crossover board can be installed. First, solder three generous lengths of tinned copper wire to the volume pot's lugs and install it to the front panel, with the lugs facing down.

Then fit the LEDs into the PCB as shown in the overlay (without soldering their legs) and slide the assembly into the front panel while feeding the pot's wire stalks through the matching PCB holes.

When you are happy with the crossover module's alignment in the front panel, tighten the rotary switch locking nut and solder (then trim) the pot's wires in place. The LED bodies can then be pushed into the front panel and their legs soldered to the board — making sure that the orientation of each LED is correct, before you proceed.

Next on the agenda is the mains AC wiring. As you can see from Fig.2 the 240V mains connections enter via the IEC socket and then connect to a short length of terminal strip, with the active

PLAYMASTER 300W SUBWOOFER AMP - 2



The component overlay diagram for the copper side of the PCB. Install these components last, after the bracket has been attached to the board.

connection passing through a 3AG fuse holder. At this point the neutral directly feeds both transformers (T1 and T2) and the mains switch neon indicator lamp, while the active passes to the transformers via the mains switch contacts — connection 'SA'.

Take particular care with this part of the wiring, and make sure that all exposed connection points are well insulated with tight fitting heatshrink or varnished cambric sleeving. Note that the 'N' and 'SA' connections on the mains switch can be identified by the small copper wires (the internal neon connections) that emerge through the body at these lugs, and these should face towards the *bottom* of the box when the switch is correctly installed.

The earth/ground wires should also be fitted at this point, as again shown in the diagram. And by the way, if you have difficulty in reaching the connections at the IEC socket with your soldering iron, try improving the access by temporarily removing the amp module/heatsinkassembly.

Next comes the unit's low voltage power wiring, which can be completed as shown in Fig.2 after the 8000uF reservoir capacitors have been installed. Make sure that the high current connections (i.e., all wiring at the reservoir caps) are formed with heavy duty insulated wire, and your soldering iron has sufficient heat capacity for the job. The 0V line between the capacitors is made from two lengths, which are joined just near the amp module's '0V' connection — as depicted by the 'blob' in the diagram.

It's important to note that this main 0V connecting point has *three* other connections (only two are shown). These are the actual 0V point on the amp's PCB (via a length of tinned copper wire), the centre-tap connection of the power transformer's secondary (T2's white wire), and the 0V or 'negative' line to the appropriate speaker terminal post on the rear panel (not shown). Also note that the 'positive' speaker post connection is shown on the amp module's overlay diagram.

When the rest of the wiring has been completed as indicated in the

PARTS LIST

Capacitors

C1	0.47uF 63V MKT
C2	1nF
C3,7,12,15,23	0.1uF 100V MKT
C4	47uF 16VW electrolytic
C5,22	10nF 100V MKT
C6	18pF ceramic
C8,9,10	56pF ceramic (150V)
C11	22nF 100V MKT
C13,16	47uF 100VW electrolytic
C14,17	100uF 100VW electrolytic
C18,19,20,21	0.22uF 100V MKT
C24,25	8000uF 80VW electrolytic, chassis mount
C26,27,40,41	0.1uF MKT
C28,29,34,37,42,43	0.12uF MKT
C30,31,35,38,44,45	0.15uF MKT
C32,33,36,39,46,47	0.18uF MKT
C48,49,50,51	470uF 25VW electrolytic
C52	100uF 35VW electrolytic
C53	1uF 25VW electrolytic

Resistors

All 1/4W 1% metal film unless specified:

R1,13	33k
R2,8,30	1k
R3	680 ohms
R4	22k 0.5W
R5	22k
R6,7	4.7k
R9,10	100 ohms
R11,12	6.8k 0.5W
R14	180 ohms
R15,16,17,18,19,20	560 ohms
R21,22,23,24,25,26	0.22 ohms 5W
R27	6.8 ohms 1W
R28	330k
R29	82k
R31	100k
R32	1M
R33	5.6k
R34	10 ohms 5W
R35,44,56,57,66	47k
R36,39,48,49,58,61	11k
R37,40,50,51,59,62	12k
R38,41,52,53,60,63	13k
R42,54,64	470k
R43,55,65	1.5k
R45,46	15k
R47	33k
R67,68	8 ohms
R69,75	3.9k
R70	120k
R71	100k
R72	820k
R73	1.2M
R74	39k
RV1	200 ohm horizontal trimpot
RV2	10k log pot

Semiconductors

D1,2,5,6,7,11	1N914 signal diode
D3,4,8,9,10	1N4002 power diode
ZD1,2	9V 400mW zener diode
Q1,2,3,4,16	BC556 PNP transistor
Q5,6	MJE340 NPN transistor
Q7,8	MJE350 PNP transistor
Q9,10,11	2SK1058 power MOSFETs
Q12,13,14	2SJ162 power MOSFETs
Q15	BC546 NPN transistor
Q17,18,19,20	BC548 NPN transistor
IC1,2,3	LF353 or TL072 dual opamp
IC4	741 opamp
LED1,2,3	Green LED, 5mm (or 3mm)
LED4	Yellow/orange LED, 5mm or 3mm
LED5	Red LED, 5mm or 3mm
B1	3504-type diode bridge

Miscellaneous

SW1	3-position 4-pole rotary switch
SW2	Illuminated SPST mains rocker switch
T1	12.6V/150mA 2851-type transformer
T2	300VA toroidal transformer, 50-0-50V

PCB, code 95swa4; PCB, code 95flt3; 2 x knobs; case with integral heatsink, 300 x 400 x 80mm; IEC mains connector, panel mount; 4 x panel mount RCA sockets (insulated); 180 x 25 x 25mm aluminium bracket; 2 x large binding posts; 3AG fuse holder, with 3A fuse; mains-rated terminal strip; solder lug; 6 x TO-3P insulating washers; PCB pins; audio shielded cable; light-duty hookup wire; heavy-duty hookup wire; mains-rated hookup wire; tinned copper wire; thermal grease; small fibre or plastic washers, 4 x rubber feet; heatshrink or cambric tubing; nuts, bolts and lockwashers; etc.

diagrams and shots of the prototype, the unit can be tidied up, the knobs and mounting feet fitted, and you're ready for the test flight.

Powering it up

Before applying power to the unit, rotate trimpot RV1 on the amp module fully *counter clockwise* (zero ohms) for a minimum output stage bias current setting, and temporarily install a 10 ohm (0.25W) resistor in series with each supply rail — the 'V+' and 'V-' PCB pins are the most convenient positions.

Then apply power to the unit, confirm that the supply rails measure close to +/- 75V, and set the voltage drop across the 10 ohm resistors to about 0.8V by slowly adjusting RV1 in a clockwise direction. While the bias current for this type of MOSFET design is not overly critical, the 0.8V figure represents a total idling current of about 80mA, which is quite adequate for this application.

Next, switch the unit off, remove the 10 ohm test resistors, then re-apply power while observing the state of the 'mute' LED on the front panel — if all's well, this should illuminate for a moment after power is connected (and again when it's disconnected). If this is not the case, check that the crossover's VS+, VS-, V+ and V- supply rails measure close to their specified levels and the LED is installed with the correct orientation.

Once you're confident that all's well, the subwoofer amp can be wired into the signal path of an existing system, and a suitable subwoofer connected to the speaker terminals. The optimum crossover frequency setting (120, 90 or 70Hz) can be determined on either a purely subjective basis, or judged from frequency response plots of the speakers involved.

For example if the subwoofer has little output above 100Hz, a crossover point of 90Hz or 70Hz would be prudent. Conversely if your main speakers run out of steam below 100Hz, the crossover setting of 120Hz would be in order. In the final analysis however, your ears will be the best judge of both the crossover point *and* the volume balance between the subwoofer and main speaker systems.

Another point that's worth considering at this stage is the power capability of the new subwoofer amp itself. While it's able to deliver a high level of continuous power as indicated in the specification panel, it's worth bearing in mind that the amp can also provide a *much* higher output power for a brief periods, such as during normal music transients. This in turn means that the driver(s) in your subwoofer enclosure could be damaged through excessive cone travel, despite a healthy nominal power rating.

In short, this amplifier has an enormous amount of 'grunt' available, so take care...❖

NOTES AND ERRATA

Low Cost Inductance Adaptor (December 1992): The oscillator stage may not function due to differing characteristics between samples of the BF245 JFET used in the level control circuit. This can usually be cured by dropping the value of R21 (33k) to around 15k, which effectively increases the loop gain around the oscillator circuit.

Also, if you are having difficulty with the calibration procedure, try the following method:

1. Adjust RV1 (10k) for an oscillator output level (at test point A) of about 1.5V p-p or 1V RMS.
2. Short the Lx input terminals with a wire link, connect a multimeter to the 'Volts' output terminals, then adjust RV3 (500k) for an 0V reading.
3. Replace the wire link with a 1k resistor, and adjust RV2 (100k) for a meter reading of 0V.
4. Connect a known value inductor across the Lx terminals (in place of the 1k resistor) then adjust RV1 (10k) for the correct multimeter reading. For a 1mH reference inductor, the reading should be 0.1V on the normal range (SW1) and 1V on the X10 range.
5. Repeat adjustment steps 2 and 3 above, then finally step 4 where RV1 should need little (or no) adjustment. ❖

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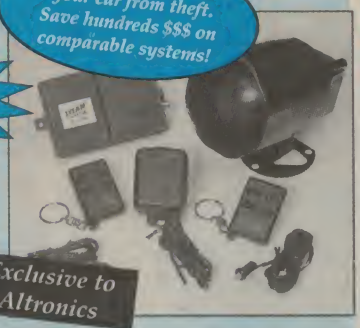

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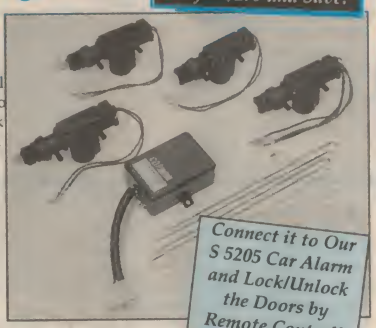

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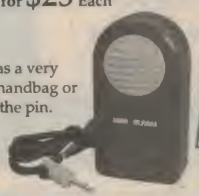

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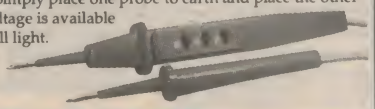

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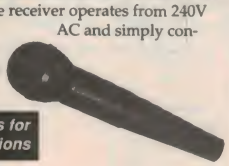

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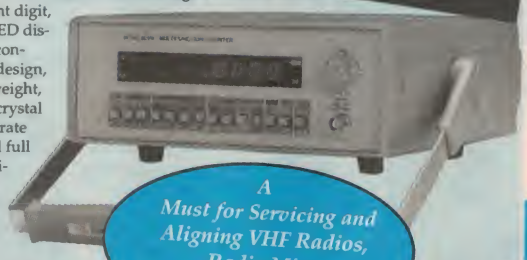

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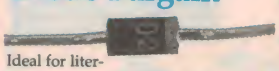

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SHORTWAVE LISTENING

with Arthur Cushen, MBE

How to verify that difficult station

Many readers are finding it difficult to obtain verifications from radio stations. In this article we look at some of the successes I have had, and the way of achieving that desired acknowledgement from a distant station.

Personally, I have not found any great difficulty in getting verifications. Granted there have been budget cuts for stations in the international shortwave field and in some cases this has resulted in a non-verifying policy. However these stations have made it known that they no longer verify reception reports, and this number is small indeed. In all cases the individual listener must look at the report he sends out, and its value to the broadcaster.

Surveys are often interesting, giving some reflections on one's performance. In a typical three month period, I sent out 40 reception reports to medium and shortwave stations and received 29 verifications - nearly 75% return on reports submitted, which would be well above the usual average.

A reader who has had some 45 years listening experience complains that he sent out five reports to five countries and none had verified. He asks for the secret to my success, as I have now verified 3000 mediumwave and 6500 shortwave stations during 58 years of listening.

Firstly, you could send a personal letter to smaller stations on AM and shortwave. Don't grind them out, or send the same type of letter or report form to each; be an individual and write to each station with a personal approach.

Start by directing your letter to a specific member of the staff. State a name or position, make your report interesting; summarise the programme heard, and give a comparison to signals from other stations in the same area and in the same band.

Describe the signal, but do not use the SINPO code as few listeners are competent enough to understand the propagation position unless you listen on a daily basis and can detect that signals have deteriorated.

The reception code the BBC, VOA and RCI all use is the SIO system, which is: signal, interference and overall rating and this could be used as you spell out the meaning of each numeral you assign to the signal. As well as describing the programme, the signals, reception conditions and your equipment, you should give some personal details such as your listening experience, your interest in listening on mediumwave or shortwave or other fields of reception.

You should enclose postage if it is not an international station, small stations can be sent an IRC. Use tourist booklets and in the case of the United States, Australia and New Zealand use mint stamps.

You can also use a prepared card for these areas. It is not as good as a personal letter, but if it is a new station they may not have had time to print a verification card so your prepared card is often appreciated as a quick means of verification.

What to use when writing to a station also has to be considered. An international station would be sent a report form like that issued by the SPARC member clubs but if it is a smaller station, then a personal letter on a letterhead of the club you belong to, or a letterhead of your own should be fine.

You should also give the stations some details of where you listened, i.e., in a city location or at a listening post which is selected for its DX capabilities. You should also indicate how your report was compiled. In my case, being blind, I indicate that the station details were recorded and from that recording a report has been compiled, typed by one of my staff and generally sent by airmail.

I have four form letters which have been photocopied. One is a report which has space for the various items to be inserted and ample room for programme details.

The second is a similar report in Spanish. The other two letters in English and Spanish are used to follow up, being sent after six months if the original report has not been verified. This follow up contains a carbon copy of the first report. If this follow up is not verified, I do not persist with further reports on the same logging, but hope to hear the station again for a fresh report.

When writing to a station which fails to reply, you should not blame the station for not answering, but rather a possible non-delivery of your letter. One station verified my report after 19 years as they had a clean up in the office and found my letter - so do not give up hope! The first report should be sent airmail and the follow up by economy mail, as the second report has lost its impact and there is no longer any necessity for haste.

If you receive a verification which the station has gone out of its way to provide then a 'thank you' note should be sent. Some stations send books, souvenirs, stickers and a personal letter and in the case of one station recently, they verified in a Braille letter.

Such acts of kindness should be thanked by writing to the station with your expression of appreciation. ❖

AROUND THE WORLD

CROATIA: Zagreb verifies with a letter to reception on 11,630kHz heard at 1900UTC. This transmitter is listed as 10kW and not 100kW as previously reported.

CHILE: Radio Esperanza, Temuco, 6090kHz has been heard at 0930 with an announcement and then recorded music. There is a further station call given at 0945 and at 0955 a spoken programme to 1000 when music is again heard. The signal suffers severe sideband interference.

Radio National de Chile, Santiago, has been sold to the former programme director of KBEI, San Francisco for a very low price according to DX Partyline. The station consists of eight 100kW transmitters and aerials, but has not been on the air for eight years and needs a major overhaul. Broadcasts are planned in Spanish and Portugese, beamed to Latin America for the first period.

GREECE: Athens has been heard on 9425kHz to sign off at 0350UTC, also on a new frequency of 6260kHz with best reception at 1900 - 1950UTC.

ITALY: RAI, Rome has commenced its broadcast to Australia after being closed in 1990, and is operating in Italian 1000 - 1100UTC. The frequency in use is 11,850kHz and this is from a BBC transmitter in Singapore. The transmission to Australia and New Zealand started recently. Transmission to this area is excellent throughout the broadcast on this 250kW transmitter.

KAZAKHSTAN: Alma Ata heard opening with English at 1830UTC on 5940kHz. The station gives full schedule details, then has 30 mintues of English.

NEW ZEALAND: RNZI's latest schedule is: 1650 - 1849UTC on 6100kHz Monday - Friday; 0459 - 0716 on 11,900 Monday - Friday; 0717 - 1206 on 9700 Monday - Friday and 1207 - 1649 on 6100kHz when required. At the weekends there is some variation in the stations opening and closing times.

VIETNAM: The Voice of Vietnam, Hanoi, has been heard in English at 0500 - 0600 on 5940kHz, with a new transmission to North America. Announcements indicate that the broadcasts are from 0400UTC and reported in 30 minute blocks. The transmitter site is presumed to be in Siberia, as after 0600 Russian domestic programmes continue on the frequency. ❖

This item is contributed by Arthur Cushen, 212 Earn Street, Invercargill New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time and 12 hours behind NZ Standard Time.

Information centre

Conducted by Peter Phillips

Baluns, CFL's and frypans

This month we examine the balun, and in particular the 1:1 'braidbreaker'. There's a bit more on operating a compact fluorescent lamp (CFL) from an inverter, and I have to justify why I include material in the column that I don't necessarily agree with...

In *EA* for March 1995, a letter from Michael Chevallier (Killara, NSW) under the heading 'Cooking' PCBs was included in the Letters to the Editor section. In his letter, Michael takes me to task in no uncertain terms about including a description from Noel Smith (Springvale, Vic) in January's Information Centre, on desoldering a PCB in a frypan.

His concern seems to be that because it's printed in a 'mostly-worthy journal', the technique will be assumed to have our seal of approval, and can therefore be regarded as a suitable one for the entire electronics profession.

Michael took particular exception to the line 'A trick is to wait until Mum goes out', in the belief that it was 'grossly irresponsible' for us to condone a lack of parental supervision in this process. He writes "Has anyone considered the possibility of persons receiving serious burns, because they regarded the article so published as to have the qualifications of editorial imprimatur? Inexperienced 'latch-key' teenagers read your publication, I'm sure."

Fortunately I'm not the only one to be unimpressed by Michael's view, and I'll open with this letter...

I was rather surprised at Michael Chevallier's reaction to Noel Smith's method of removing components from PCBs by heating the board in an electric frypan containing cooking oil. Mr Chevallier seems to have missed the point.

I assume Mr Smith is an impecunious hobbyist who has rescued some PCBs from the rubbish and has hit upon an idea to remove the components for reuse. Any components he is able to salvage are a win. If some die from thermal shock, so what! All they have cost him is a bit of time, maybe the odd burnt finger and a bit of Mum's cooking oil.

If there is an oil residue on the component leads, he can either scrape it off or throw the component in the bin and use the one that isn't so contaminated. After all, a hobbyist isn't making a commercial-grade piece of equipment, much less a milspec one. If a component fails in a circuit he has built, due to the ingress of moisture resulting from thermal shock, the hobbyist extends his knowledge by further finding the fault, and replacing the component with another from a cast off PCB.

The technique I use for extracting components from PCBs, and there are lots of them in old VCRs, is to clamp the PCB vertically in a vice and heat the solder side with a propane torch. The solder melts immediately and the components can be removed quickly, with only a few solder joints being heated at a time. However, I praise Mr Smith for a resourceful and innovative technique that requires no special equipment. (Keith Gooley, VK5BGZ.)

Thanks for your letter Keith; I couldn't have said it any better. Incidentally, Keith is the author of a construction project in the March '95 edition, called 'A Calibrated Detector Probe'. Somehow we managed to misspell his surname, so our humblest apologies.

As I think most people will realise, I included Noel Smith's letter in the column as it described a technique the writer had found successful. I also introduced the letter with the comment "I'm not sure I want to try it", and concluded that "it seems rather hard on the ICs".

Surely that's enough to indicate that we weren't exactly giving it the 'thumbs up' as a desoldering technique. To not include the technique is a form of censorship, that means anything I disagree with doesn't get in the column. Instead I take the view that readers are sensible enough to make up their own mind and I include material on the basis of whether it's likely to be of interest.

Certainly I agree that desoldering in a frypan is likely to cause damage to the components (as I pointed out), but I believe that readers, even 'latch-key teenagers' are aware of the dangers of a hot, oil-filled frypan.

As well, I'm sure readers will realise without being told that the desoldering process, however it's done, is hazardous to both the components and the person doing the job. If we continually pointed this out, half the magazine would go in warnings, and most of our readership would cry "enough! we know that heat causes burns".

Now that I've got that off my chest, it's on to the esoteric area of baluns...

Baluns

In the December '94 column, a reader (R. Kirkham, of Wembley Downs, WA) asked for a description of how a balun works, and in particular about a 1:1 balun that could be used as a 'braidbreaker'. This device is connected in the coaxial line from an antenna to a receiver, such that it cuts the braid of the coax. Apparently, it can often remove some types of electrical interference picked up by the braid.

My answer concentrated on the workings of a balun, but didn't address the original question. Since then, Mr Kirkham has written again, with a few observations and a repeat of his original request. However, his is not the only letter on the subject. Here's what Mr Kirkham has to say...

Thank you for the explanation of the

workings of a balun. I won't claim to fully understand it, but I'll accept it as being valid. I have since reconnected the balun as described, and there appears to be further improvement of the picture. Perhaps the first improvement was due to the removal of a rather heavy film of aluminium oxide on the connecting surfaces.

I have since found another construction of a commercial balun, this one having separate cores for the two bifilar windings. The connections correspond to your references, except there is no ground connection to the line linking the input ends of the secondary windings. I intend to try this balun but, without a signal strength meter, it's difficult to judge how the performance of each balun compares.

But I come back to the start of this saga. I want to build a 'braidbreaker' or 75 ohm to 75 ohm isolating transformer, to operate over the TV signal spectrum. Can you refer me to a suitable design? (R. Kirkham, Wembley Downs, WA.)

Before I attempt to answer the question here's part of another letter on the subject, this one expressing dissatisfaction with my explanation of the workings of a balun:

I found your discussion of baluns in the December issue very interesting. It presents a kind of paradox which is rare in electronics these days. The circuit looks wrong but it works! However your explanation left me unsatisfied.

You claimed that the bifilar windings behave as if they are quarter-wave transmission lines. However, there is no way they could be a quarter wavelength long over the whole frequency range. But surely it is now possible, using more modern materials or construction methods, to develop a balun which is both better and cheaper to make. There can be few other components which have remained unchanged for so long. (Harry Freeman, Wollstonecraft, NSW.)

Mr Freeman's letter also included some observations on the construction of a balun he found in a junk box, but as we've covered that aspect, I've not included his description here. So the first thing I need to do is give another explanation on the operation of a balun, if possible without mentioning transmission lines. Unfortunately I can't do that, as this is like discussing resistance without mentioning Ohm's law. But the following extract, from a US book called *Transmission Line Transformers* by Jerry Sevick, might help a little.

The balun transformer is a subset of the general class known as transmission line transformers. This class differs greatly from conventional transformers where energy is transmitted from input to output by flux linkages. Instead, energy is transmitted by a transmission line mode, and the conventional current flow is prevented by the choking action of the coiled transmission lines.

The balun, as well as other forms of the transmission line transformer, does not have a primary winding or a secondary winding as such. Its operation in the passband, where only transmission line currents flow, is analysed purely by transmission line theory.

The objectives then are: (a) to have sufficient reactance in the coiled transmission lines to prevent the unwanted conventional current, (b) to select the proper characteristic impedance to optimise the high-frequency response and (c) to minimise the parasitics which eventually reduce the inductive reactance of the coiled transmission lines at high frequencies to unacceptable values.

To date, practically all of the 1:1 and 1:4 balun designs, excluding baluns

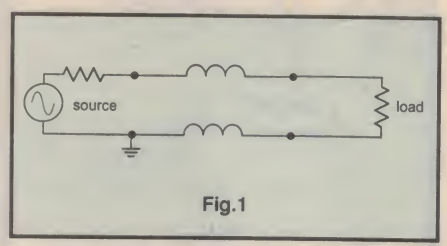

Fig.1

using ferrite beads or 1/2 and 1/4 wavelength sections of transmission line, have used the schematics of Ruthroff which were presented in his classic paper in 1959.

But the earlier paper by Guanella in 1944 also presented schematics for the same baluns. For reasons unknown to the author, Guanella's baluns were not favoured. After examining many forms of the balun over the past two years, and from feedback from the first edition of this book and discussions with many colleagues, it became apparent to the author that Guanella's approach is the preferred one.

What follows is a quite detailed explanation of how a 1:1 balun works, including a design by the out-off-favour Ruthroff. I'm not including it here however, as there are no constructional details. As well, it appears (and Mr Ruthroff apparently agrees) that its design has an unnecessary winding.

I'm mentioning this to convince you that balun design is more of a 'black art' than antenna design, as even the gurus (Ruthroff *et al*) can't get it right.

The author also describes a design of a 1:1 balun by the favoured Guanella, which is nothing more than a coiled bifilar winding. The circuit diagram of this balun is in Fig.1. Here's what Mr Sevick has to say about this design...

It should be noted that the characteristic impedance of the 1:1 balun is assumed to be the same as that of the coaxial cable which is connected to its terminals. This is true with the Guanella balun using #14 or #16 wire with very little spacing between the wires, and ample spacing (at least one diameter) between adjacent bifilar turns.

However, when extra insulation such as Teflon tubing is employed, the characteristic impedance can become two or three times greater than that of the coaxial cable, and the input impedance can differ widely from that of 50 ohm cable, even at reasonably low frequencies.

While a 1:1 balun can be wound on a straight piece of ferrite rod, it appears the toroid gives a better performance. Included in the book are photographs of actual 1:1 baluns, but unfortunately all the designs are for amateur radio, rather than TV. The nearest design I can give is this one, which has a bandwidth of 1.5MHz to over 50MHz. The dimensions are imperial (being a US publication), and I've left them as such in case my metric conversions are wrong.

A 75 ohm 1:1 Guanella balun has 12 bifilar turns of #14 (2mm dia, I think) *wire on a two inch OD (50mm), K5 toroid (mu = 290). One wire is covered with 17 mil* (0.4mm, I think) *wall Teflon tubing to increase the characteristic impedance to 75 ohm. This design can handle up to 2kW of power.*

So, there's the basis for the design of a braidbreaker, although its frequency response may be the major limitation for a TV transmission line. But there may be simpler ways, as described in the *1990 ARRL Handbook*, Chapter 16. The subheading to the text I'm quoting is Choke Baluns:

A more direct approach to the objective of choking off outside currents on the coaxial feeder is to form the line into a coil at the antenna feed point. Choke baluns of this type are broadband in nature. Ten turns of coaxial line coiled at a diameter of six or eight inches (150 to 200mm) form an inductor with enough series reactance to minimise unwanted current at frequencies from 14 to 30MHz. (The turns can be held in place with electrical tape.)

However, the effectiveness of a choke of this type decreases at higher frequencies because of the distributed capacitance among the turns.

Another type of choke balun that is

very effective was originated by M. Walter Maxwell. One or more ferrite beads may be placed over the outer shield of the coax where it is connected to the antenna. The beads present a high impedance to RF currents that would otherwise tend to flow on the outer conductor.

Bead materials of various sizes and RF characteristics are available. By using a stack or a 'sleeve' of appropriate beads over ordinary coaxial line, a choke balun may be made to cover a broad frequency range, such as from two to 250MHz.

While I've examined a great number of books to get more details of baluns, and in particular a suitable design for a 1:1 braidbreaker, this is all I can come up with. It appears that most books on the subject are for amateur radio, not TV. Still, hopefully I've answered our two letters, although I'm painfully aware that the explanation I've given is neither simple, nor conclusive.

TV problem

The next letter is one many TV repairers will empathise with. Our correspondent is not really complaining, but do I detect a bit of frustration?

I read with interest your reply to PV of Perth in the August '94 issue of EA (Industry Associations) and was reminded that my TV set was taken to a repairer who displayed the TESA membership sign. The set had a vertical hold problem, its first fault since new.

At the time of reading your column my set was still at the repairer, whom I have contacted on a monthly basis. Each time I was given a different reason for the delay, such as waiting for parts, a circuit diagram, fixing another fault that had not previously shown up, and so on.

I have finally collected the set, but it still has an obscure fault which was not present when I took it in for repair. The repairer suggests that it's an unusual problem which causes a 'colour loss, possibly due to an out-of-phase identification signal'. The fault appears at each channel change, but comes good if the set is changed off the channel then back on.

So, I'm calling for help. The repairer has exhausted all avenues through TESA and other colleagues without success. The receiver is a Toshiba Black Stripe, model C-820, purchased in 1977. Has anyone experienced this fault? (Barry Ring, Croydon Hills, Vic.)

I've had Barry's letter for a while, but I imagine he is still having to flip channels to get a colour picture. Incidentally, as far as I recall, an out-of-phase ident signal doesn't cause a loss of colour, instead it causes the wrong colours. I'd be looking at the colour killer section, not the ident stage.

Still, if a reader can help with this fault, I'll be happy to pass it on to Barry and include the details in this column.

Energy saver lamps and inverters

In the April '95 column I described a way of driving energy saver lights (compact fluoro lamps, or CFLs) from a 24V to 240V 50Hz inverter. This followed a letter from a reader complaining that CFLs driven from an inverter often had a lifespan of around 10 hours, rather than the advertised lifespan of 8000 hours. While the technique I described works, I've now learnt that there are at least three types of CFLs, and that the method will only work with one of these.

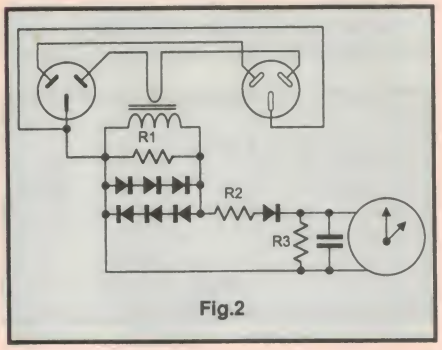

Fig.2

The technique is to connect a bridge rectifier comprising four high-speed switching diodes and a 0.47uF 400V filter capacitor, between the inverter output and the lamp. This means the lamp is operated from a DC source, which overcomes failure of the diodes in the input rectifier caused by the square wave output of the inverter.

The first type of lamp that can't be used with this system are those fitted with a conventional ballast and starter. These lamps are quite heavy, and include the Philips SL Comfort Energy Saver range. The other type is all electronic, and includes those lamps where the tube is a plug-in item to a base that contains the electronics. You'll find more details about these lamps in a construction project (possibly in this issue, or soon) titled CFL and Fluoro Lamp Inverter.

A simple test to see if the lamp is the correct type for use with a DC supply is to measure the current taken by the lamp. If the power input is about equal to the rated power output, all is well. Otherwise, forget it.

Energy auditor

Our Circuit and Design Ideas section is often grist for material in this column. Here's a letter from a regular contributor to this column about a design in the January '95 edition.

The Energy Auditor by R.C. Hilton presented in your Circuit and Design Ideas section in January '95 is an excellent concept. In its present form, the two strings of 1N5404 power diodes are there to give enough AC voltage drop to operate a 1.5V clock.

The catch is that if one wants to monitor a heavy current such as a hot water system or air conditioner, these diodes need to be expensive, heavy current devices. And an interest in energy auditing is likely to involve heavy power appliances rather than the light ones.

As a 1:1 transformer is specified, what about replacing it with a current transformer (CT). Only a tiny current at 1.5V is needed to run a clock, and the diodes can be basic 1N4004s or similar. The CT can be almost anything resembling a transformer, providing one or more turns of single power cable can be wound over the coil as the primary.

Naturally it's important to always have a load on the secondary of a CT, provided in the original circuit by R1. However, a loosely coupled, even poorly designed CT might be preferable here, in case the secondary load is disconnected. After all, it's not for current measurement purposes, simply to drive a small clock.

A small toroid slipped over the power cable could also be used, assuming a secondary winding was already wound on the toroid. (Ron Voller, St Georges Basin, NSW.)

Thanks for this simple but effective modification to a useful circuit idea, Ron.

The circuit diagram with Ron's CT is shown in Fig.2. While Ron's original circuit showed the CT in the active lead, there's no reason to not have it in the neutral, as shown in Fig.2.

240V Master-slave

The next letter discusses a topic somewhat related to the last, except the problem concerns small load currents rather than large ones.

I recently built the 240V Power Relay project, (January '92) for use with my sound system. This device operates by detecting the load current of a 'master' appliance and applies power to other appliances when the master appliance is switched on. A great idea.

My plan was to use a VCR as the

master unit, but I found that because it draws a standby current, it is always switching on the slave units. Can you describe how I might be able to modify the circuit so the switching threshold can be adjusted to detect the two current levels?

I have tried increasing the value of the triac gate resistor R3, reducing the value of R2, even reducing the number of shunt diodes. All this does is give a 'soft turn-on' to the slave appliances. That is, rather than 240V, there's only 160V AC. (Jack Chatzi, Mt Waverley, Vic.)

This circuit relies on the current taken by the master appliance developing a voltage drop across a group of diodes. Unfortunately, this arrangement can't really differentiate between different values of current. In fact, this was pointed out in the article, where the current taken by a suppression capacitor connected across the incoming mains of a master appliance took enough current to operate the slave.

A possible modification, assuming the device is used with a specific appliance, like a VCR, is to connect a resistor in parallel with the diodes. The value of this resistor would need to be determined by experiment, selected so that the stand-by current of the appliance can pass through the resistor without developing enough voltage drop to forward bias the diodes. However, its resistance should be high enough to ensure the normal operating current of the appliance gives the necessary 1.8V required to forward bias the diodes and operate the triac.

I haven't tried this idea, but I have tried the Master Control Power Switch presented in January 1990. In fact I've had one of these on my sound system for some years. This project is more complex, but has an adjustment to allow for a stand-by current. I think it will better suit your needs.

Variable speed CD

In February I included a letter from a reader seeking information about fitting some sort of speed control to a CD player. The next letter throws more light on the subject.

I am writing in response to the letter from Alan Boulton who asks about pitch control CD players. As an electronics technician I have never seen a CD player modified in this way, although I have seen the Denon unit and the Teac model referred to by Mr Boulton.

A CD player uses constant linear velocity for the tracking of the disc. This means that the CD starts at about 486 to 586rpm and then slows down to about 196 to 228rpm at the outer edge of a 12cm disc. The rotational speed of the disc is critical and any attempt to slow the disc will cause mistracking. This is why a CD player cannot be modified in the same way as a cassette deck.

Basically the CD player uses a reference crystal oscillator running at 8.4672MHz and two servos, the speed (coarse) servo and phase (fine) servo. These two servos alter the speed of the disc depending on how fast the unit can take the information from the disc. The crystal oscillator is the master reference for the CD player and this is what eventually determines the speed of the music. Any change to the oscillator frequency will change the pitch.

But be warned, this is not the sort of project for the average enthusiast, as there is a lot more to a CD player than I have described. Any modifications would require an intimate knowledge and a circuit diagram of the unit. (Gary Watts, Geelong, Vic.)

Thanks for your technical summary of a CD player, Gary. As you say, modifying it to give a variable speed output is not for the faint-hearted or the beginner. However, given that there are commercial units available, one wonders how the variable speed is achieved. Also, is the musical pitch held constant for each different tempo? I'd love to know!

What??

Here's a problem I've adapted from a book called *101 Puzzles in Thought and Logic*, by C.R. Wylie Jr. It's quite simple, but I wonder how many people will get the right answer...

A solar-powered car is travelling from A to B. Although town A is at the same level as town B, the road between them is all hills. If the car averages 20kmh going up a hill, and 60kmh going down, then assuming no time is spent at the top of a hill, what is the average speed of the car for the whole trip?

Answer to April's What??

The output voltage is +1V. The gain of A1 is (-10k/140k) with an input of 140V. The output voltage of A1 is therefore (-10/140) x 140 = -10V. The current through R6 and R7 is 140/(0.1 + 13.9) = 10A. The voltage at the top of R4 is therefore 140 - (10 x 0.1) = 139V. The output voltage of A2 is (139 x (-)140k/140k) + (-10 x (-)140k/10k) = (139 x -1) + (-10 x -14) = -139 + 140 = 1V. The circuit is practical, as the output voltage of both op amps is within the usual specification for an op amp and the inputs are at, or close to zero (because of the virtual earth created by the feedback). ❖

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EXPERIMENTING

Continued from page 49

and we can put this to good use in a number of audio circuits. Shown in Fig.7 is a sample circuit which should give you plenty of room for experimentation.

It is basically a DC-controlled volume control. As the wiper of pot VR1 is moved towards the +5V supply, the diodes are further pushed into conduction and the signal is shunted to ground. As you rotate the pot the other way, the diodes continue to turn off further and further, which results in more signal appearing at the output.

Strictly speaking, you only need one diode to do this, but by having two diodes, you balance out the voltage shift caused by the DC in the audio signal as well as slightly improving the distortion. While you can forget about getting hi-fi quality results, it does work quite effectively and I've used it in a couple of popular kit designs.

One area where you can easily experiment with this circuit is to replace the pot with a waveform generator such as a triangle oscillator, to produce a simple audio amplitude modulator. You can achieve some interesting audio effects, such as a 'Cylon' or 'Dalek' voice, by feeding in the audio sound from a microphone circuit to the input and feeding a 2.5kHz squarewave in place of DC to the pot wiper side of the diodes.

Simple power supply

Finally this month, here is the circuit for a simple two voltage DC power supply (Fig.8). You can use it to power up your own circuits, but it will also be great to use with the circuits we'll be presenting in future editions of EWE.

A standard extension of the full wave voltage rectifier circuit we've already looked at, we only require the addition of a few components to come up with this useful supply. Switch S1 simply switches the regulator to provide either 5V or 9V output, by shunting one of the feedback resistors to ground. You can obtain other voltages by varying the 150 ohm resistor. Obviously, the lowest voltage you can get is 5V but don't increase the 150Ω resistor above 220Ω, as the regulation characteristics of the regulator begin to decrease markedly.

Well, there's nine circuits to get you started with diodes, but we've really only scratched the surface. Except where noted, a 5V power supply is adequate for most of these and subsequent circuits.

Next month, we'll move onto some transistor circuits and further expand some of the ideas we've started here. ❖

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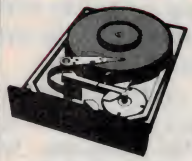

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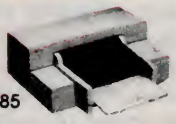

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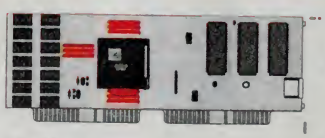

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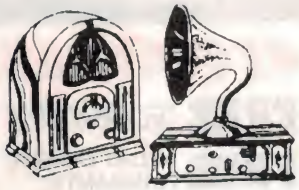
Vintage Radio

by PETER LANKSHEAR



Restoring a monster

Many collectors keep a lookout for radios from the interesting period around 1930 — when most receivers used simple tuned radio frequency (TRF) amplification, and had evolved into impressive devices built like battleships. This month we look at typical project involved in bringing one of these beasts to life.

For radio manufacturers, the late 1920's were a busy period with rapid changes. The major problems of successful mains powering had been solved, and with the introduction of the screen grid valve, adequate and stable RF amplification had become possible.

High power audio valves were now available to drive the increasingly popular moving coil loudspeakers, but created greater demands on power supply current capability. Higher voltages and improved filtering were necessary, spurring on the development of electrolytic capacitors. Safety, the size and weight of power supply components, and RF stability had required baseboard construction to give way to massive pressed steel chassis. Progress was rapid, and by 1931, anti-trust litigation having forced RCA to relinquish its patent monopoly, there was a wholesale change to the more efficient superheterodyne. This abandonment of the 'big TRF' coincided with the expansion of the Australian radio industry following the banning of the import of complete radios.

Many of the pre-1931 receivers surviving today are American built TRF types and the chassis from one of these, the 1930 Columbia AC-9-30, is the subject of this months 'adventure'. As can be seen from Fig.1, it is very massive — weighing about 20 kilos — and has an equally substantial early Jensen speaker to match.

There were several American firms selling radios with the Columbia label, the best known being the Columbia Phonograph Company of New York, whose chassis came from various suppliers during the late 1920's and early 1930's. However, this month's receiver is from the Columbia Radio Corporation of Chicago, a much smaller and short lived company which marketed receivers during 1929 and 1930.

As can be seen from the photograph, the chassis is quite long, with the four RF stages and detector in a row along the centre line. In front of these is the shielded four-gang tuning capacitor. Running transversally are the audio and rectifier valves, while at one end are the rectangular boxes containing the power transformer and filter capacitors.

Covered in dirt

When it arrived on my workbench, the Columbia chassis appeared to be in a bad way. Not only was it covered in dirt, straw and rubbish better left unidentified, but there were ominous signs of very black pitch deposits and overheating around the power transformer. Fortunately, the free standing loudspeaker appeared to be in good condition, with the cone intact.

Inverting an ancient chassis for the first time is a bit like the first look at lottery results. There is always an uncertainty as to what will be revealed; so it was with a degree of anticipation mixed with trepidation that I removed the base plate and looked underneath. Fig.2 shows what was revealed. I had half expected to find less than pristine wiring, but this had undergone a lot of mutilation, and was very untidy. As there clearly had been various servicing sessions, with quite a number of more modern replacement components, the next procedure was to sit down with the chassis and the circuit and quietly compare the two.

For the restorer of American equipment, John F. Rider's *Perpetual Trouble Shooter's Manuals* are invaluable. Rider brought out massive loose-leaf volumes annually from 1930 onwards, later editions running to something approaching 2000 pages per volume. In these are circuits and service data of all the major US manufacturers' receivers, and probably 90% of the lesser brands.

So it was to Rider that I referred, and sure enough, there in Volume III was the circuit of the Columbia AC-9-30. (Not much imagination needed in selecting a type number by the way: obviously I wanted a 1930 AC model with nine valves). The circuit is also identified as SG-9, probably the identification given to the chassis and cabinet combination.

Of course, many prospective restorers will not have reference sources like

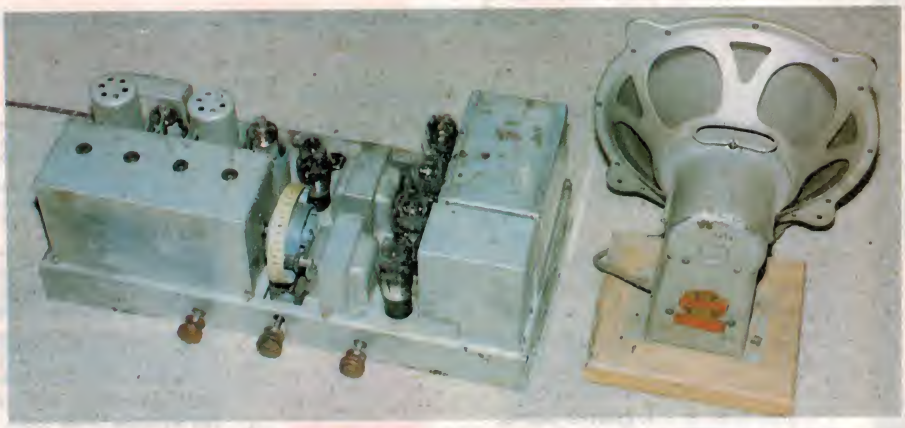


Fig.1: By the year 1930, receivers like this Columbia TRF had grown to massive proportions.

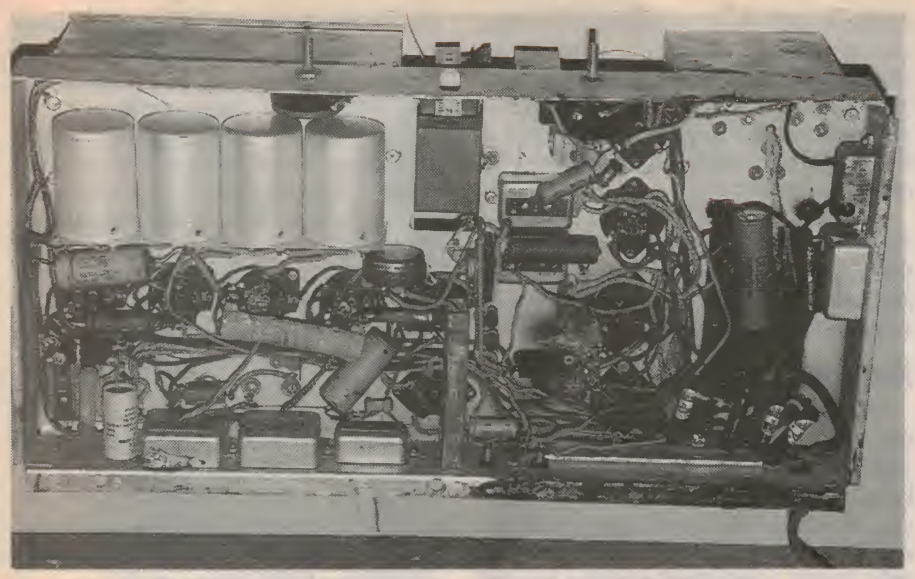


Fig.2: A couple of fires, and numerous component replacements had left the underside of the Columbia's chassis in a disorganised state.

Rider, but I would remind readers that both the HRSA and NZVRS have extensive libraries of circuits and data available to members. Addresses for membership applications are given at the conclusion of this column.

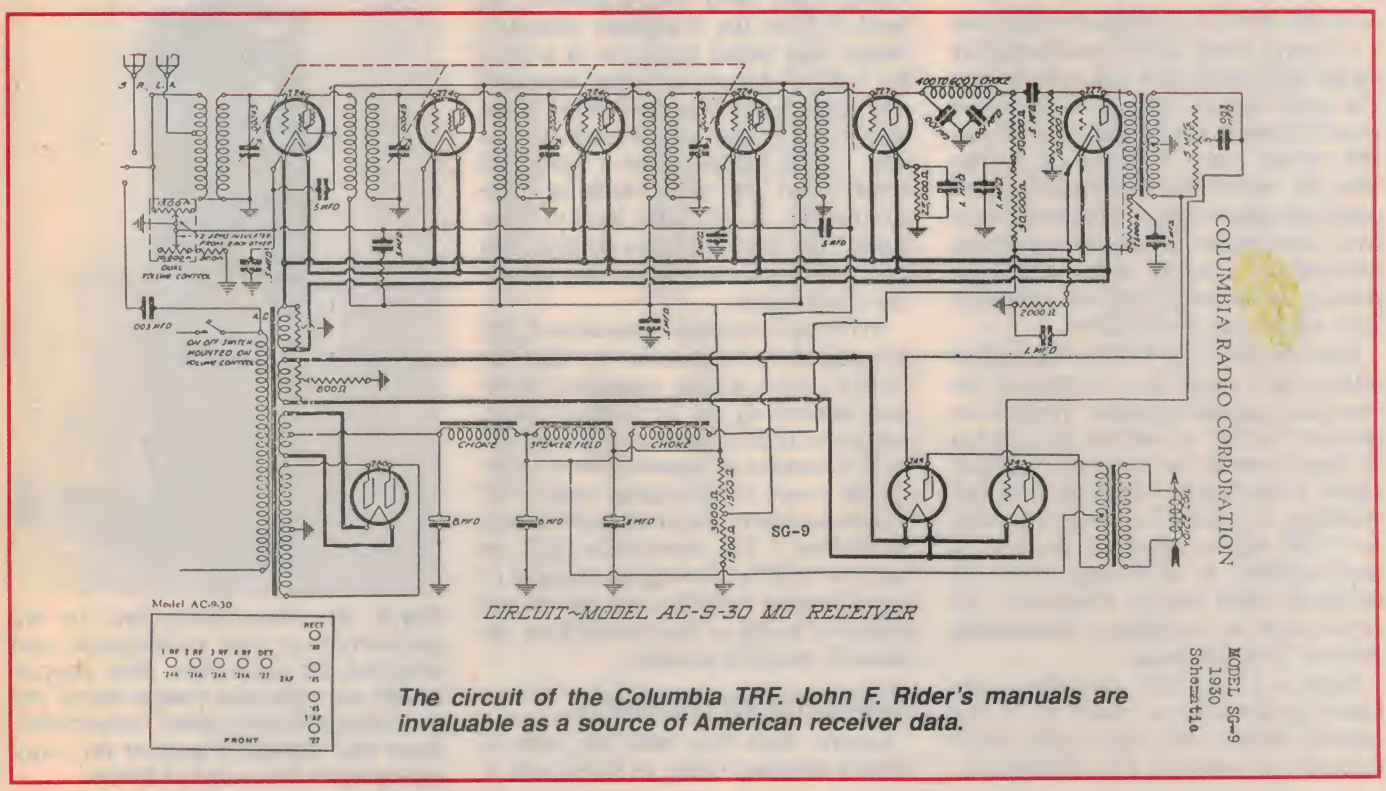
Without the circuit, tracing the wiring would have been a time consuming exercise, and it would have been very hard to identify modifications with certainty. The configuration turned out to be typical of larger screen grid receivers of the period, and it is interesting to compare it with that of the contemporary but nominally obsolescent all-triode Majestic Model 90B, described in this column for August 1992.

Starting with the input terminals, there is provision for three different types of aerial. Long aerials ('long' meaning more than about 20 metres) are connected to a tap on the primary winding of the aerial coil. Short aerials are switched to the full primary winding. The third alternative is a mains aerial, with the aerial winding being connected to the mains via a switch and small capacitor. This type of aerial connection was useful as an alternative to a proper installation, for obvious reasons of economy and convenience. House wiring, and overhead service lines, pick up a useful amount of RF and 65 years ago, there were fewer devices with commutators, fluorescent lights, TV timebases and computers creating interference. In fact, for use in high signal strength areas, it was possible to buy adaptors, each containing nothing more than a small capacitor, to screw or plug into lamp sockets for connection to receiver aerial terminals. This method is not recommended today, especially for 240 volt mains!

Volume control

Two major difficulties with the new 224 screen grid valves were obtaining effective volume control and cross modulation from strong nearby signals. Inserting a variable resistor between the aerial and the receiver certainly provided positive control of volume and cut down cross modulation interference from other programmes, but the receiver then operated continuously at full gain, creating a very noisy background. Alternatively, varying the screen or cathode voltages of the RF stages controlled their gain, but the sharp grid cutoff characteristics of the 224 meant that a worthwhile increase in bias, or reduction in screen voltage created serious nonlinearity, increasing cross modulation and distortion.

The best compromise was to provide,



The circuit of the Columbia TRF. John F. Rider's manuals are invaluable as a source of American receiver data.

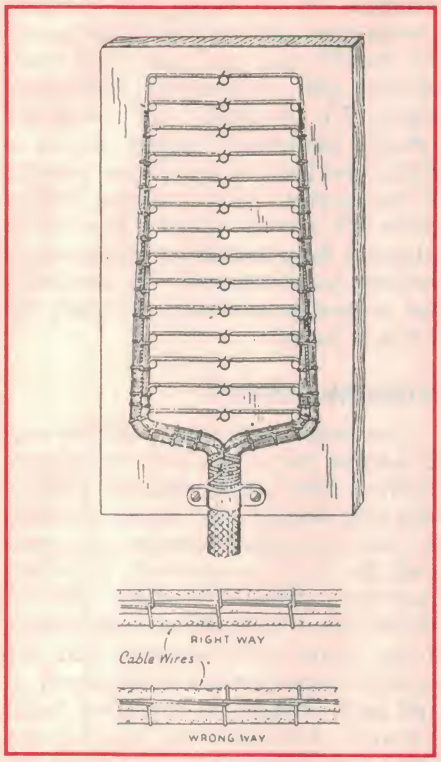


Fig.3: These old drawings show the use of a template to pre-form a telephone wiring loom, and how the correct method of lacing prevents unravelling. Some early and professional radio equipment used this system for wiring chassis.

as in this receiver, combined controls on a common shaft which simultaneously varied both aerial input and cathode bias. The aerial section has a 1500 ohm wire wound element, but the bias control has a 10k carbon track. Fortunately, in this case, the control was in reasonably good condition, otherwise some ingenuity may have been needed for repairs. As it was, dismantling, cleaning with mineral turpentine and relubricating with petroleum jelly was all that was required.

Four identical 224 RF amplifier stages follow, each tuned by a section of the four-gang variable capacitor. This section provides the bulk of receiver gain, and as all stages operate on the same frequency, stable amplification demands thorough shielding and short leads. No less than six 0.5uF bypass capacitors are used to assist stability. As technology improved, designers used smaller capacitors, but relied more on isolating or decoupling resistors in supply leads.

Next is a type 227 detector valve, biased practically to cutoff by a 25k cathode resistor, and with its grid driven through an untuned RF transformer. Audio amplification is provided by what was at the time virtually a standard arrangement of a 227 general purpose triode — transformer coupled to a push-pull pair of 245 triodes, biased with a single 800 ohm resistor between the filaments and earth.

The massive power supply, with the inevitable type 280 rectifier, is typical of the period. Chokes provide hum filtering and the loudspeaker field is part of the voltage dividing system.

Restoration viability

A check with a test meter showed that the chokes and audio transformer windings were intact. It would have not been at all surprising to find at least one of the audio transformers with an open circuited winding. However, the only major component needing repairs was the power transformer. It seemed therefore, that restoration could be a practical proposition.

A more detailed inspection showed that there had been two 'fires' in the set's history. The first was probably the result of arcing across the rectifier socket, which had caused most of the soot and blackening visible in Fig.2. Some of the wiring loom had been damaged, and repairs had involved removing the lacing thread and cutting off the damaged portions of some leads. The second fire came from the burnt out power transformer and was more serious.

It was very common to use looms for wiring these early sets, a practice inherited from the telephone industry. Rather than install leads one at a time, the bulk of the wiring, other than grid and anode leads, was pre-formed externally from colour coded leads. It was then cabled together into a loom and either bound with woven braid or, more commonly, laced with heavy linen thread. The loom was then dropped into the chassis and connected to the sockets and components.

Although largely abandoned for domestic radio construction by the early 1930's, laced wiring continued to be used extensively for professional grade equipment until the advent of printed circuits. Examples of especially neat looms can be found in Australian made STC communications receivers built during World War 2. The drawings in Fig.3 are from the 1920's, showing an example of a pre-forming template, and the correct method of lacing so that at each knot, the thread is locked in position.

Repairing vs restoring

Looms were fine until the chassis needed servicing. Often, as in this case, it was necessary to alter the configuration of the wiring to suit replacement components. Consequently loom lacing had to be undone with untidy results.

This brings us to an important aspect of dealing with very old receivers such as the Columbia. In early equipment, paper capacitors were usually enclosed in metal boxes, often in multiple, and wirewound resistors were frequently built as a common unit. Over the years, these may have been replaced by more modern wire-ended components, physically quite different from the original types. This, along with the fire damage, was to a large extent responsible for the Columbia's untidy appearance.

It is easy in these circumstances to accuse servicemen of shoddy workmanship, but they worked under serious constraints. Performance of the receiver, after repairs, would be little different with meticulously positioned components. Rather, the customer was generally only interested in getting the receiver back in good working order as soon as possible and at minimum cost. The successful serviceman was the one who could diagnose a fault accurately and quickly and then make rapid and reliable repairs.

Today, as restorers, we can take as long as necessary to bring the receiver back to as close to original condition as possible with few cost constraints — a

Fig.4: An interesting link in the evolution of the traditional wet electrolytic capacitor, this copper cased example was hidden inside the box alongside the power transformer. Note the threaded socket for easy changing in the event of failure.

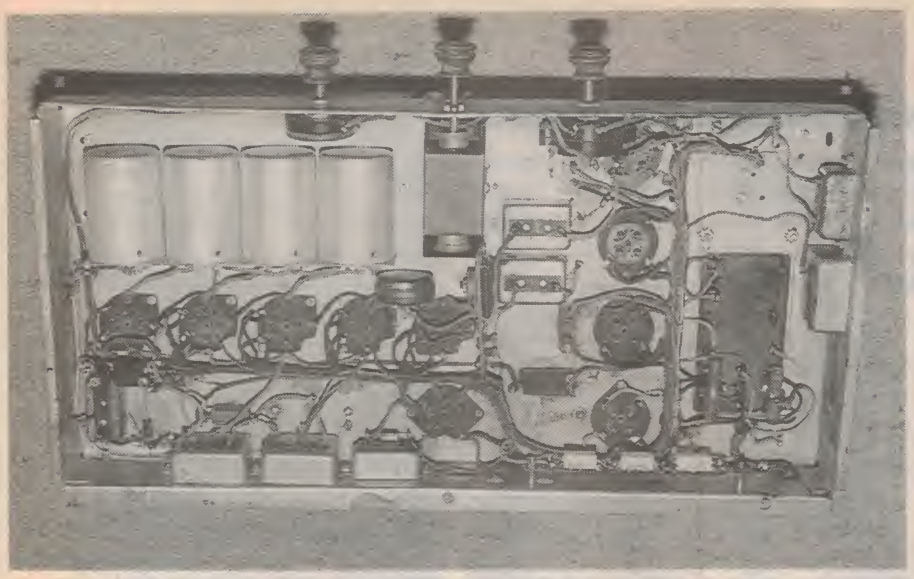


Fig.5: A view underneath the receiver following the author's restoration job. Compare this with Fig.2, to see the amount of work that had to be done.

Utopian situation that most servicemen could only have dreamed about. The prime object today is not rapid repairing of faults, so much as returning the receiver to as near as possible to original condition, and in the process, not creating further damage.

We must not forget too that there were many backyard 'servicemen' —handymen with a enough knowledge to get some sort of life from an ailing receiver. A lot of their success came from a 'try it and see what happens' experimental approach, and their workmanship could vary from competent to downright poor, with soldering that looked as if it had been done with a poker, or even no soldering at all.

Frequently too (and there was evidence of this in the Columbia), they would fit the nearest available but inappropriate replacement component. One example can be seen left of centre in Fig.1, where a large 25 watt resistor of the wrong value has been used to replace a 5-watt section of the voltage divider (mounted on the right hand rear of the chassis).

Capacitor surprise

Apart from the major project of rewinding the power transformer, to be covered later, restoration of the Columbia was straightforward, entailing renewal of resistors and of the contents of the capacitor boxes, and replacement of the damaged and shortened leads before relacing the wiring loom.

The original capacitor contents were removed readily from their boxes by digging out the embedding wax and pitch, and modern plastic dielectric capacitors were easily fitted in as replacements. One small problem was working out, largely by a process of elimination and deduction, which box (most of which were dual units) had originally contained which capacitors.

There was a small surprise waiting when the large above-chassis filter capacitor box was removed. The original three 8uF capacitors had long since been disconnected, and replaced by cardboard cased electrolytic capacitors visible in the under chassis photograph.

The filter capacitor box was unbolted, and found to contain not a tightly packed group of paper filter capacitors (which it was obviously originally designed for), but instead three unusual copper-cased electrolytic capacitors, one of which is shown in Fig.4. 1930 was a period of rapid advances, and probably what had happened was that the development work on the chassis had been based on using paper filter capacitors, but by the time that production was under way, the cheaper and higher capacitance Mershon electrolytics had become available.

These copper cased capacitors proved to be an interesting evolutionary type. They are the same size as the standard aluminium cased wet type that were to be found in many chassis made during the 1930's, but they are mounted in a threaded brass socket, with the terminal at the top end. No doubt the elaborate mounting was to facilitate replacement in the event of failure — a likely possibility with the new and relatively unproven type of capacitor.

The use of higher value capacitors than the original design would have called for may explain the unconventional arrangement at the output of the second filter choke — which is connected to the resistors supplying the anode current of the two type 227 valves. Normally the junction would have been bypassed to earth, to provide additional filtering. As it is now, the choke serves little practical purpose, and in fact, savings could have been made during manufacture by its elimination. At 100Hz, a 20 henry choke has a reactance of about 12.5k, which is of no great significance when compared with the 25k and 50k resistors in series with it.

Three high wattage resistors comprising the voltage divider and output stage bias resistor were originally in a 'Kandohm' unit, a flat wirewound strip that was clamped in a tinplate cover, hence the name. The elements had long since failed, and as repairs are not very easy, it was replaced by three standard five watt resistors mounted on a strip of fibre. Of course, if a genuine voltage divider of the correct type ever turns up, it will be a simple matter to install it.

The major exercise of the project was dealing with the burnt out pitch-encased power transformer. This warrants an 'in depth' description, and it also involved some calculations. As space has run out, next month's column will describe how this was done, and as well we'll look at power transformer voltages generally and hints on selecting replacements.

Here once again are the addresses to write to for membership applications for the vintage radio societies:

Historic Radio Society of Australia
Mr J.R. Wales
PO Box 283,
Mt Waverley, Vic 3149.

New Zealand Vintage Radio Society
Mr B. Marsh,
20 Rimu Road,
Mangare Bridge, Auckland 1701. ❖

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

May 1945

Tubes measure cloud ceiling: Consistently accurate readings of cloud ceilings are provided by a pulsating light system using a phototube detector. Developed by Laurence W. Foskett, US Weather Bureau, in conjunction with General Electric Lighting engineers, the system measures the height of clouds two miles up in daylight for the first time in aviation history.

2,000,000 volt Xray tube: If all the radiographic equipment previously in existence, plus all the radium mined to date, could be concentrated on the taking of a single radiograph through 12in of steel, it would require a longer exposure time for the job than would a two million volt X-ray tube recently introduced by Machett Laboratories, of Springdale, Conn, US.

Besides high voltage, the new tube involves precision focusing of the electron beam to produce practically a point source of X-rays.

May 1970

External heart monitor: Scientists from the Stanford University School of Medicine and NASA's Ames Research Centre have successfully tested the application of ultrasonics to check the functioning of the human heart. The tests provided information on the heartbeat and blood circulation of the heart chambers, and by taking X-rays and blood samples.

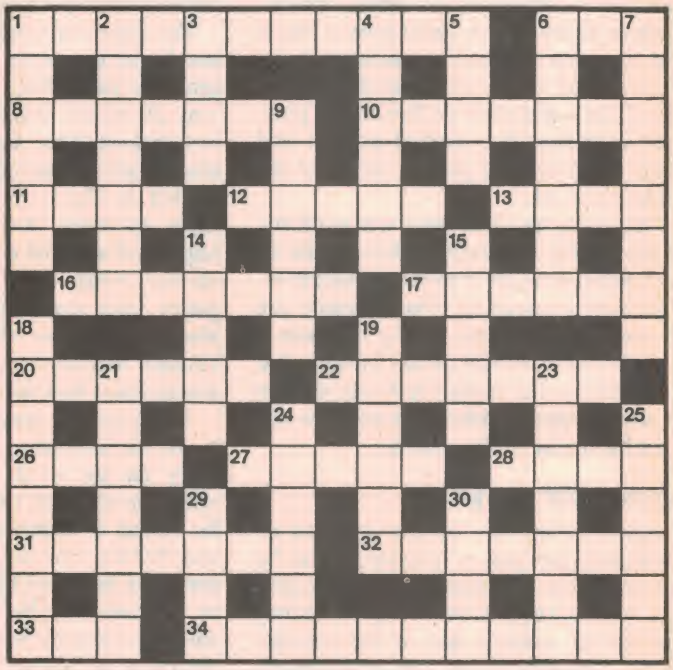
Ultrasonic studies of the heart can be done by a well trained person in the doctor's office or at the patient's bedside in a matter of minutes. The system can be applied as a screening procedure for patients with suspected heart disease and to monitor the healing process in patients recovering from heart surgery or from a heart attack.

Transmitters for TPNG: Acting on behalf of the Papua and New Guinea Posts and Telegraph Department and the National Broadcasting Service, the Australian Post Office has ordered 10 2KW broadcast transmitters from Amalgamated Wireless (A'sia) Ltd.

Some of the equipment is to replace existing installations in the National Broadcasting Service, and some is to establish a new broadcasting network in the Territory. Six HF transmitters are to be installed at Madang, Goroka, Lae, Mount Hagen, Kerema and Port Moresby. Four MF transmitters are to be installed at Madang, Goroka, Lae and Wewak. Deliveries are due to begin in August.

Hydrogen around comet: A large hydrogen cloud has been discovered surrounding the comet Tago-Sato-Kosaka. The cloud was detected by instruments aboard NASA's Orbiting Astronomical Observatory 2. The hydrogen was detected by its radiation in the far ultraviolet regions of the spectrums. Preliminary data indicate that the glowing cloud of hydrogen surrounding the head of the comet is as large as the Sun.❖

EA CROSSWORD



ACROSS

1. You're into this word Australia. (11)
6. Major Australian TV channel. (1,1,1)
8. Adjuncts to permanent magnets. (7)
10. Peter Lankshear's speciality, —— radio. (7)
11. Assign a value, standard or condition. (4)
12. Long distance communication. (5)
13. System of correspondence. (4)
16. Article on Tom Moffat. (7)
17. Circuit item. (6)
20. Base SI unit. (6)
22. Complement of green. (7)
26. Couple. (4)
27. Items for data storage. (5)
28. Card entry point of an ATM. (4)
31. Basis for many dyes and plastics. (7)
32. Device giving graphic display. (7)
33. Unwanted noise in hi-fi. (3)
34. Part of a computer. (11)

SOLUTION FOR APRIL 1995

	T	R	A	N	S	P	O	R	T	A	B	L	E	
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DOWN

1. With Mauchly he built the UNIVAC computer of 1951. (6)
2. Prefix meaning 'caused by electricity'. (7)
3. Items used to tidy cable runs. (4)
4. Devise a new gadget or system. (6)
5. Major electronics manufacturer. (4)
6. Leakproofing item. (7)
7. Radar absorbing technology has made planes so. (8)
9. Move display on screen. (6)
14. Time units. (5)
15. Motion of CRO beam. (5)
18. Comparative pictorial display. (3,5)
19. Make a copy of data. (4,2)
21. Chip by Intel. (7)
23. Communications organisation. (7)
24. Transfer calls, etc. (6)
25. Sent data to memory. (6)
29. Thin layer. (4)
30. Type of filter. (4)

Electronics Australia's

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INTEL REVEALS ITS NEW 5.5M TRANSISTOR P6 PROCESSOR

PHILIPS GROUP WINS 20 PAY TV LICENCES

REVIEW OF PROTEL'S NEW ADVANCED SCHEMATIC 2.2, ADVANCED PCB 2.6 CAD PACKAGES FOR WINDOWS

NEW GENERATION OF HARD DISK DRIVES FROM MICROPOLIS OFFER A MINIMUM SUSTAINED TRANSFER RATE OF 4M BYTES/SECOND — 35% FASTER FOR REAL-TIME DIGITAL AUDIO AND VIDEO APPLICATIONS

NEWS HIGHLIGHTS

FURTHER SOLAR ENERGY BREAKTHROUGH

A further Australian breakthrough in the area of solar photovoltaic energy conversion has been claimed by a team of researchers at the Australian National University (ANU). Led by Dr Andrew Blakers, a former UNSW scientist, the team has developed a thin-film solar cell with a conversion efficiency of 17%, which is claimed as a world record. It also believes it has found an ideal initial market, to support development of solar photovoltaic energy in Australia.

The thin-film cells are expected to be cheap to produce, and can be used with parabolic trough reflectors to improve their power output. Dr Blakers expects that within three years, the cost of producing energy with the new cells will be low enough to displace diesel-powered generating plants in remote towns, mining camps and homesteads. This market, he believes, gives Australia a significant competitive advantage over solar companies elsewhere in the world.

"The market for solar cells in the diesel mini-grids in Australia is worth up to $1.5 billion. Together with markets in Asia that are hundreds of times larger, the diesel fuel displacement market can absorb all of the output of the Australian photoelectric industry for 10-15 years, even with large production growth rates."

"It isn't necessary to look for competitiveness with grid electricity for many years, until this wonderful 'stepping stone' market is eventually saturated."

NASA/RUSSIAN SPACE STATION AGREEMENT

NASA and the Russian Space Agency (RSA) have signed a protocol complementing an agreement reached between Lockheed Missiles & Space Co. and Russia's State Research and Production Space Center (Khrunichev), for the US purchase of the Russian Functional Energy Block (FGB). The FGB will be launched in November 1997 as the first element of the international Space Station.

NEW HEAD OFFICE FOR ROD IRVING

Computer, kit and electronic component supplier Rod Irving Electronics has opened a new facility in Vermont, in the eastern suburbs of Melbourne. The company is transferring its headquarters to this facility, which is located at 190 Rooks Road; phone (03) 874 8888, or fax (03) 874 2288.

A feature of the Vermont site is a large and impressive retail sales showroom, with excellent facilities for demonstrating computer systems as well as the latest merchandising for electronic components, tools and computer accessories. The new building also incorporates an expanded office complex, as well as a larger warehouse and customer parking area.

Company founder Mr Rod Irving said that the new Vermont facility will allow RIE to provide customers in the eastern suburbs with more convenient access to computer and electronics technology at competitive prices, and also to improve the working conditions for its own employees. The enlarged office facilities will also allow RIE to expand its in-house production facilities for advertising and marketing — including production of its monthly *Communicate* newsletter to customers.

BIG SUCCESS FOR WYONG FIELD DAY

This year's annual field day held on February 26 at Wyong NSW, hosted by the Central Coast Amateur Radio Club, continued the tradition of previous events as Australia's largest amateur radio event. Around 2500 amateurs and electronics hobbyists attended, and as usual found much to interest them.

Most of the suppliers of amateur radio and associated equipment had displays and sales stands, including Dick Smith Electronics, Icom Australia, Emtronics, Daycom, AV-COMM, Oatley Electronics and RCS Radio. A large 'boot sale' area outside also attracted much interest, although the hot weather caused some 'wilting' of both stallholders and customers as the day wore on.

There were displays by the IPS Radio and Satellite Services, and many amateur radio organisations including the WIA, WICEN, Gladesville Amateur Radio Club, The Australian Amateur Television Club, the Australian Amateur Packet Radio Association, the Fisher's Ghost Amateur Radio Club and the Castle Hill Military Radio Collection.

Among the many technical presentations during the day were talks on amateur microwave communications by pioneer Lyle Pattison VK2ALU, who was recently awarded the 1995 Wilkinson Award for services to amateur radio. Lyle held the world record for a 70cm EME (earth-moon-earth) contact for a period, and last October achieved a world record EME contact on 10GHz with WA7CJO.

The protocol reflects acceptance by the two space agencies of contract terms negotiated by Lockheed and Khrunichev. It also guarantees, with no additional cost to NASA, the launch of the FGB on a Russian Proton booster, and navigational control in orbit and related engineering, integration, logistics, maintenance and training support for the FGB.

The Lockheed agreement with Khrunichev, a subcontract to NASA's prime Space Station contractor, Boeing, calls for the design, development, manufacturing, test and delivery of the FGB at a price of US$190 million.

After initial use as a propulsion module, the FGB will serve as a fuel storage module and a service area, which will provide living and experimentation space as well as backup guidance, navigation and control. In addition, the FGB will serve as an integral part of the Space Station's overall power and information subsystems.

IMPROVED BONE TESTING INSTRUMENT

Technology developed by a team from NASA, a major US university and a small business is making it possible to directly and non-invasively measure the stiffness of long bones. NASA is interested in using the technology to test the bones of astronauts, who lose calcium from their weight-bearing bones during space flight.

The instrument, known as the Mechanical Response Tissue Analyzer (MRTA), is a portable device that detects the response of the bone to a brief vibratory stimulus, to measure the bending stiffness of the bones. The bones that can be tested are the ulna in the forearm and the tibia in the leg.

The instrument was developed by NASA's Ames Research Center of Mountain View CA, Stanford University of Palo Alto CA, and Gait Scan Inc., of Ridge, New Jersey.

"The major attraction of this technology is the speed and simplicity with which the measurement gives a complete picture of bone strength", said Sara Arnaud MD, of Ames' Life Sciences Division. Arnaud said that a long bone will bend before it breaks, with a stiffer bone requiring more force to break it. Bending stiffness is a mechanical property of bone that reflects both the materials in the bone and its shape.

The MRTA is the only instrument that provides a direct and non-invasive measure of bending stiffness in the ulna and tibia, she said.

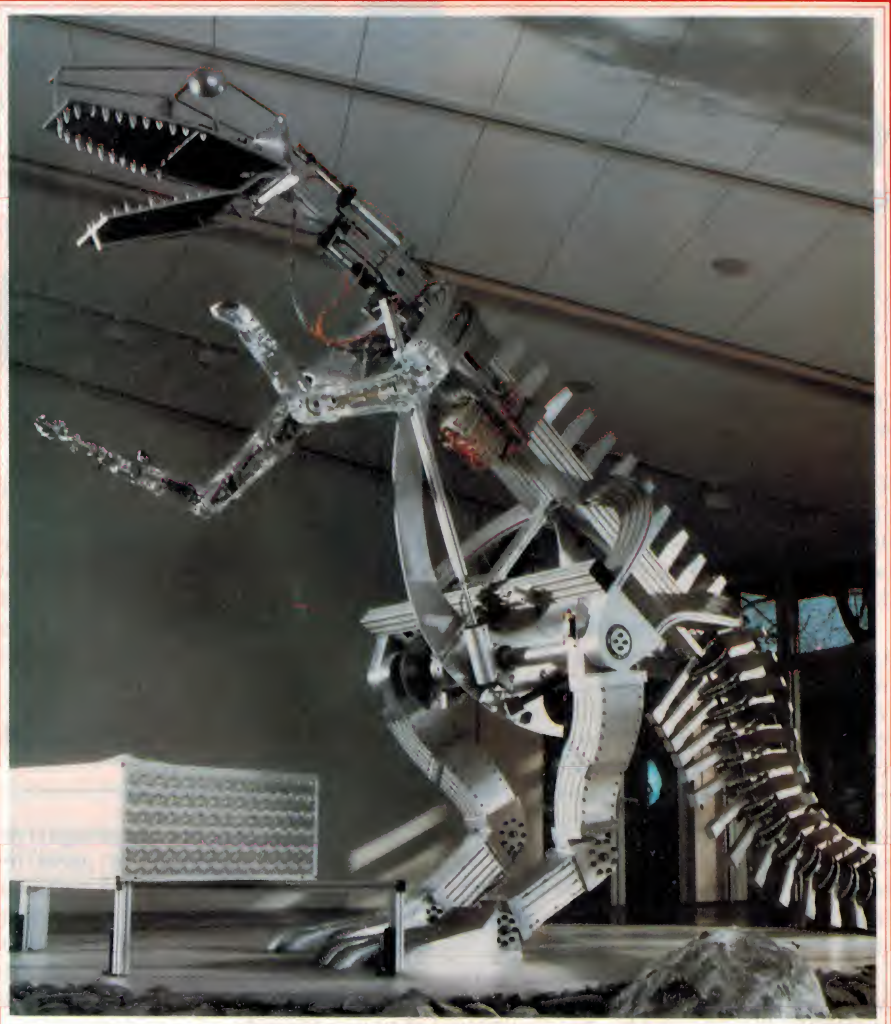
Among the MRTA's advantages are its safety — because it uses no radiation — and the ease of measurement. A technician places a small probe on the skin surface of the limb to be tested, which rests on a stable support. The patient feels a 'buzz' that lasts less than five seconds.

The frequencies from the resonating bone are detected at the same site as the stimulus and analysed by special software in an attached computer. The result is an accurate measurement of the bending stiffness of the bone. In addition, at an approximate cost of US$20,000, the MRTA is fairly inexpensive.

Arnaud noted that while the MRTA is not yet in clinical use, it has been used in several research studies of the forearm bones. She is using the device to measure the strength of the leg's tibia bone among working women at Ames.

In other research, the MRTA accurately showed the fragility of bones in patients with osteogenesis imperfecta, a disease marked by brittle bones and increased risk of fractures.

Scientists also have used the device to measure the strength of bones in the forearms of women with postmenopausal osteoporosis.



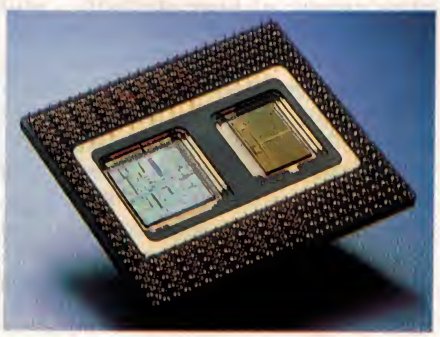
German electronics company Weidmuller Interface built this novel aluminium version of Tyrannasaurus Rex, for use in exhibitions. Siemens Industrial Automation provided the electronics to make the 'monster' move in a realistic way. Five metres tall and weighing two tonnes, it can move its three metre long tail and bend its knees in a scarey posture, in response to touch screen controls operated by visitors.

INTEL REVEALS P6 PROCESSOR

Intel Corporation has disclosed details of the first fruit of a parallel engineering effort, the next generation P6 microprocessor, at an engineering conference in San Francisco. The presentation of technical details follows the delivery of first working samples to OEMs.

The 5.5 million transistor chip will deliver the highest level of processor performance for the Intel architecture when systems using the chip begin to ship in the second half of this year. Intel says P6 will achieve this performance using a novel combination of technologies known as Dynamic Execution.

Dr Robert Colwell, P6 architecture manager, explained that this architectural enhancement is the next step beyond the superscalar advance implemented in the Pentium processor. Dynamic Execution is a combination of technologies — multiple branch prediction, data flow analysis and speculative execution — that is constantly feeding P6's data crunching units. Intel engineers were able to implement Dynamic Execution by analysing how billions of lines of code in software programs are typically executed by processors.



A system level approach means the P6 will be the first high volume microprocessor with two die in a single package. A dual cavity, standard PGA package contains a P6 die and a companion level two (L2) cache memory die. The two chips communicate using a highly optimised bus which contributes to high performance by tightly coupling the processor to its primary data source.

At introduction in the second half of this year, the P6 processor will operate at 133MHz and will use a power supply of 2.9 volts. The low voltage also contributes to low power dissipation, which is expected to be only about 14 watts, typically, for the processor and L2 cache combined. Complete performance and power dissipation information will also be available at that time, although estimated performance has been measured at more than 200 SPECint92 on a prototype system, twice the performance of today's fastest Pentium processor.

PHILIPS PRESIDENT COMMENTS ON DVD

At a press conference in Eindhoven, the Netherlands, following the release of Philips international results for 1994, the question of digital Video Disc standards was raised, specifically about the speculation of whether the Philips-Sony or the Toshiba developed disc will become the world standard.

Philips international president, Jan Timmer, replied: "It is not unusual in the world of consumer electronics, and other worlds, that we have systems which are competing with each other. It is natural for inventors of systems to want to unveil their work and display their skill, but, this has not always been in the best interests of the consumer."

"But I believed discussions about the two systems would be more fruitful if they could be held out of the public eye. The confrontation has not been resolved yet, because it is not yet absolutely clear which system fulfills the highest expectations."

"These expectations are that the system is 'future-proof', that it would be equally effective in both the consumer electronics and computer worlds, as they increasingly integrate, and have an economic life of at least 25 years."

He added: "This has to be studied carefully, and we think we should ask the opinion of the computer industry as well. We want to have a discussion on a broader level than is going on currently."

PHILIPS GROUP WINS PAY TV LICENCES

PPV, a company closely associated with Philips Electronics Australia, has been allocated 20 licences for non-satellite pay TV broadcasting services.

Philips is a 20% shareholder in PPV, with the remaining shares held individually by three of Philips' local directors and a company secretary.

PPV will primarily be providing a near video-on-demand movie service to its subscribers, with up to seven channels at any one time dedicated to narrowcast of a single title, permitting subscribers to access movies of their choice at a selected commencement time. Several movies will be available at any one time to subscribers.

Mr Justus Veeneklaas, chairman of Philips Electronics Australia, said: "The award of the licences to PPV is another initiative by Philips into the full range of multimedia services and technologies. Internationally, Philips is a leader in video-on-demand technology via ADSL. We believe that broadband's great capacity can best be utilised by moving to video-on-demand, and Philips intends to be a leader in this market."

INTEGRATED COMMS FOR ARMY'S COMMAND

Siemens Plessey Electronic Systems (SPES) has achieved a significant milestone in the RAVEN Combat Net Radio (CNR) Programme, with the delivery to the Army of the Gold Standard RAVEN Communications System for the M577A1 Armoured Command Vehicle. With this system Battlefield Commanders have access for the first time to a fully integrated, secure/non-secure, Command Communications System in an armoured vehicle.

RAVEN HF and VHF radios have been integrated into the vehicle's intercommunications harness, which was also developed under the RAVEN programme, greatly increasing the vehicle's operational capability. There is capacity for the simultaneous operation of four VHF and two HF stations, all in secure and Electronic Counter Counter Measure (ECCM) mode. This improved capability is particularly significant for operations in northern Australia, a region of growing importance for defence units.

"Vehicle integration is a vitally important aspect of the RAVEN programme," said Col. Kym MacMillan, RAVEN Project Director at the Department of Defence. "The SPES team has worked closely with us to evaluate user requirements and to build trial installations. The final installation designs and techniques developed by Siemens Plessey will now be used by the Army to undertake vehicle modifications," he said.

SPES has achieved world wide recognition as a leader in vehicle integration for tactical military communications systems. In addition to the RAVEN development the company has also provided communications integration expertise to both British Aerospace and General Motors of Canada for the Australian Surface Light Armoured Vehicle (ASLAV) project.

NEWS BRIEFS

- ***Cray Communications*** has announced the appointment of Mr Greg Dyer to the newly created post of Logistics Manager for Asia Pacific.
- The 11th Hong Kong International Computer Expo Systems show ***Computer '95*** will be held at the Hong Kong Convention and Exhibition Centre from May 24-27, 1995. For more information contact Business & Industrial Trade Fairs, 18/F First Bank Centre, 56 Gloucester Road, Wanchai, Hong Kong, phone (852) 2865 2633.
- ***Optical Systems Design*** has moved to 7/1 Vuko Place, Warriewood, Sydney 2102. The PO box, phone and fax numbers remain the same.
- ***Zatek Australia*** has been appointed representative and distributor for CTS Corporation, manufacturer of optical data links.
- Mr Gil Thew has been appointed Managing Director of ***SunSoft Australia***, a subsidiary of Sun Microsystems.
- The 12th Thai ***Computer and Communication Marketplace*** will be held in the Queen Sirikit National Convention Centre, Thailand, November 23-26, 1995. For more information, contact Thai Trade Fairs 822/1 Rama VI Road, Phyathai, Bangkok 10400, phone (662) 215 6555. ❖

TELECOM DEVELOPS SECURITY PHONE

Australia has achieved significant advances in the encryption of top secret telephone, fax and data transmissions, making them impervious to eavesdroppers anywhere in the world.

Telecom Australia has produced the world leading Speakeasy encryption device, which has just achieved accreditation by the Australian Defence Signals Directorate (DSD) for use by Australian Government agencies.

DSD accreditation means Speakeasy can be used for the protected transmission of all levels of nationally classified and sensitive information. Speakeasy is claimed as the only encryption device in the world capable of protecting voice, fax and data on both ISDN and traditional PSTN telephone networks.

Mr Bill Osborne, Telecom Senior Product Manager - Speakeasy, said Telecom has begun supplying the device to Government agencies in Australia. In the interests of national security, Speakeasy has been designed and built for the exclusive use of Australian Government agencies.

"Speakeasy is about the size of a metropolitan phone book and can be carried in a briefcase," he said. "This portability together with its high voice quality and low speed operation makes possible its convenient use at remote sites and indicates its potential value for Government officers in remote areas of Australia or travelling overseas."

Speakeasy is connected in between a telephone, fax or PC and a telephone network. Operation is simple; a caller dials a number in the usual way and when a connection is established, both the caller and the person answering push buttons on their respective Speakeasy boxes. This immediately activates the encryption system, which remains functioning until the parties hang up and again punch the buttons to de-activate the system.

RADIO SOCIETY CELEBRATES 75 YEARS

Sydney's Waverley Amateur Radio Society is celebrating the completion of 75 years as an Amateur Radio Society. The Club was established on the 13th February, 1919 in the Waverley Shire, and is the oldest radio society in Australia.

It celebrated informally on Wednesday night 15/2/95 with Mr Gordon Thomson as the guest speaker.

Gordon was one of the original founding members of the club, and is the oldest amateur in New South Wales. He has seen radio communications progress right through to the modern use of voice communications, amateur television, and data transmission around the world using radio networks through the ionosphere and by satellites. ❖

Solid State Update

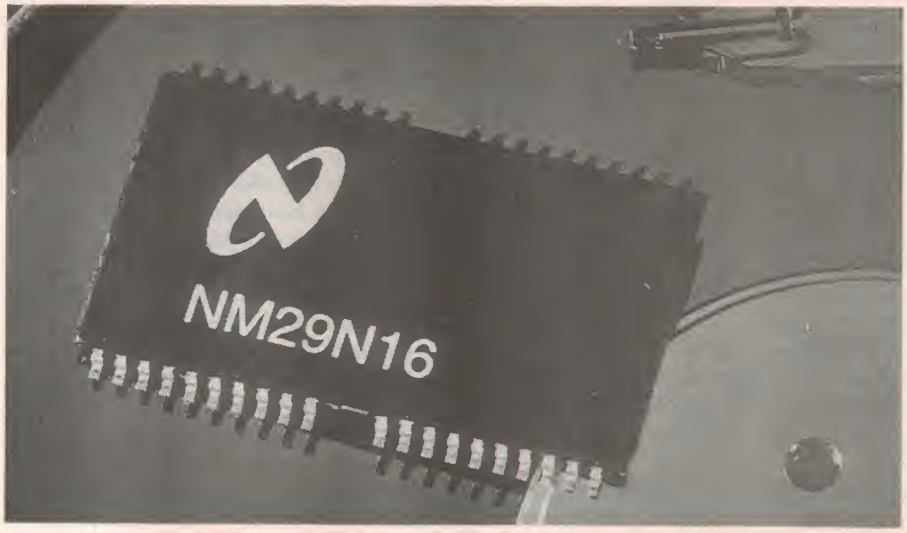
KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Hard disk on a chip

National Semiconductor has announced its high density, single 5V supply, 16Mb (2MB) flash memory device, the NM29N16.

This non-volatile read/write memory features a serial interface in contrast to the parallel interface of first and second generation NOR flash devices. NS claims the device mimics the operations of a standard hard disk drive, making it the 'world's smallest hard disk drive'.

The NM29N16 flash devices suit file storage system applications. Existing NOR flash devices are slow in comparison to hard disk drives because of their slow write transfer rates (0.1 - 0.3MB/sec versus a hard disk drive's 2.4MB/sec). NAND flash based solid state disk drives eliminate this bottleneck.



Internally, data is organised in an array of 512 blocks of 4KB each. Each block is organised into sixteen 264 byte pages. Read and program access is by 264 byte pages, while erase access is by block. Once a page has been read, individual data bytes can be accessed in 80ns. The NAND flash serial interface design approach yields a much smaller package size and results in a system interface that resembles the interface to a hard disk drive.

For further information circle 272 on the reader service coupon or contact National Semiconductor (Aust), 16 Business Park Drive, Monash Business Park, Notting Hill 3168; phone (03) 558 9999.

PCI chip set for Pentiums

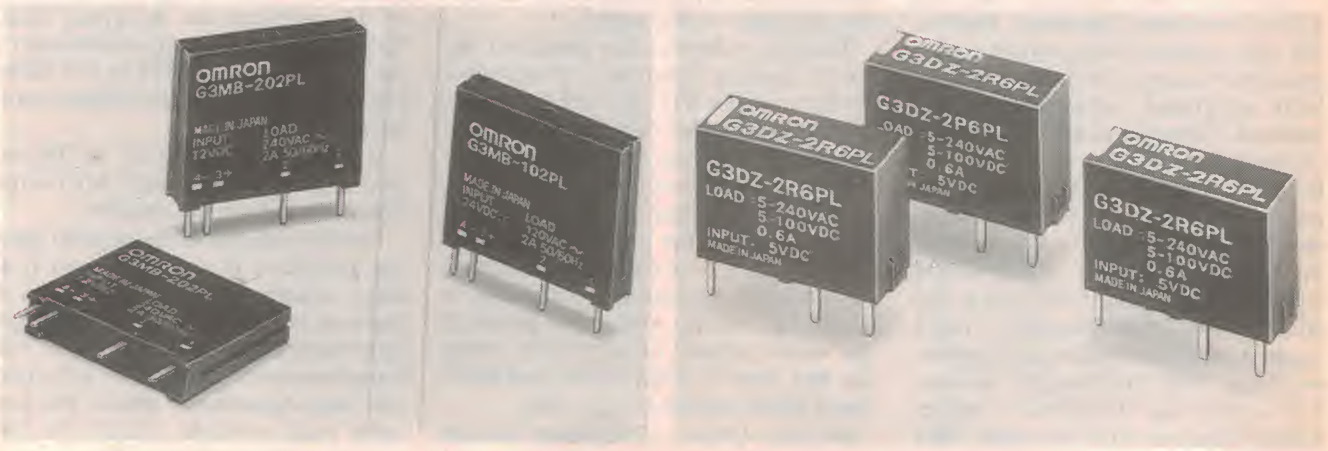
Intel has introduced the newest family member in its PCI chip set, a third generation Pentium processor chip set claimed to run Windows applications up

Miniature SSRs

Omron Electronics has released two miniature solid-state relays (SSR). The first is the model G3MB. This relay measures 5.5 x 24.5 x 20.5mm and allows high density PCB mounting. It has 5V, 12V and 24V DC control inputs and can switch up to 240V AC at 2A, with an isolation voltage of 2.5kV. The relay can be operated in a conventional phase control application, or it can be supplied with a zero-crossing function.

The second device is the G3DZ, which features a MOSFET control element for switching both AC and DC voltages at up to 600mA. This relay measures 12.5 x 6.5 x 17.5mm and has a 10uA leakage current with 2.5kV isolation. It also has control input voltages of 5V, 12V and 24V DC.

For further information, circle 271 on the reader service coupon, or contact DGE Systems, 103 Broadmeadow Road, Broadmeadow 2292; phone (049) 61 3311.



to 30% faster than its predecessor and other chip set products currently on the market. The 82430FX, also called 'Triton', is a four component chip set that features PCI bus mastering IDE, a plug-n-play port for ISA peripherals and 100MB/sec PCI data streaming.

The Triton chip set enables Native Signal Processing (NSP). NSP is a cost effective way to run PC applications which demand more system resources for multimedia signal processing.

The set comprises four components: The Triton system component (TSC), the Triton data path (TDP), and the PCI ISA/IDE accelerator (PIIX).

Two TDPs are used to complete a system. The TSC is the core of the chip set, and together with the TDP (the path to memory) forms a host PCI bridge that provides functions such as a 64-bit host bus interface, a 32-bit PCI interface, a 64-bit main memory interface, a write back, second level cache interface, a host and PCI address decoder, and a PCI bus arbiter.

The PIIX multi-function component provides the bridge between the PCI bus and the ISA expansion bus and also serves as the PCI bus master IDE controller. It integrates functions found in ISA based PC systems with a fast local bus interface and a motherboard plug-n-play port for such devices as a Sound Blaster compatible chip set.

For further information circle 274 on the reader service coupon or contact Intel Australia, PO Box 1486, Dee Why 2099; phone (02) 975 3300.

Power transistors have 150mV sat voltage

Handling a continuous collector current of 3A, the Zetex SuperSOT range of SOT23 packaged switching transistors feature a maximum saturation voltage of 200mV, making them well suited to battery powered applications.

Proprietary matrix chip design and optimised thermal packaging give the complementary FMMT617 and FMMT618 SuperSOTs high gain and high power dissipation characteristics. The transistors can dissipate 625mW with a peak current of 12A, at a minimum gain of 80.

The FMMT617 NPN device can drive heavy loads including stepper motors, infrared LEDs and moving message displays. At a continuous current of 3A, the transistor has a typical gain of 320 and a typical saturation voltage of 150mV.

For further information circle 278 on the reader service coupon or contact GEC Electronics Division, 38 South Street, Rydalmere 2116; phone (02) 638 1888.

16-bit audio delta-sigma DAC

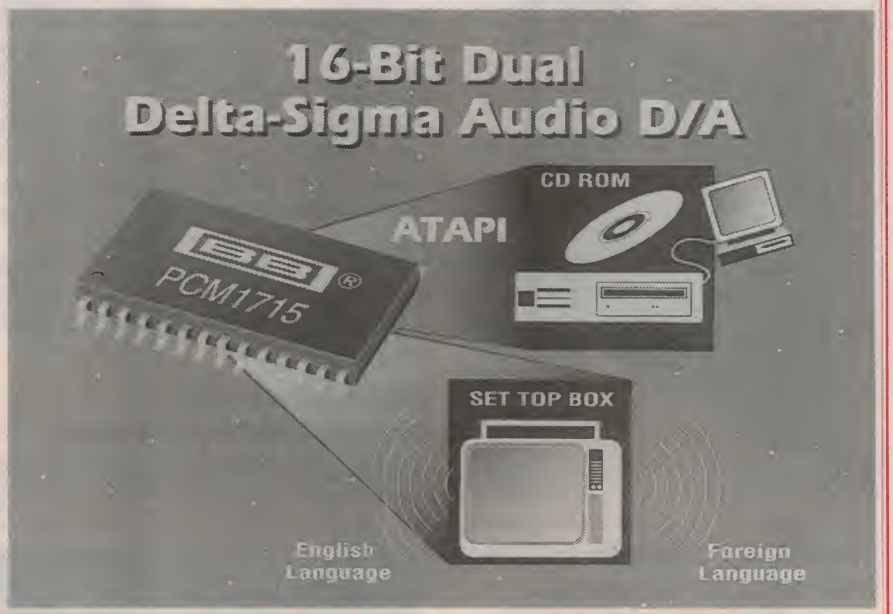
Burr-Brown's new PCM1714 is a low cost, dual, voltage output CMOS D/A converter. It incorporates multi-level 4th order delta-sigma architecture, which reduces sensitivity to input clock jitter and RF interference. Its ability to support separate L and R digital attenuators, and flexible analog output mode selection make the device suitable for CD-ROM, CD-i, video CD, tuners, set-top box, and other digital audio applications.

The on-chip digital filter has -62dB stop band attenuation and a +/-0.008dB ripple in the pass band. The digital attenuator has 255 steps with provisions for separate control of left and right channels, which makes it compatible with the newly adopted industry-standard ATAPI (AT attachment packet interface) extension for CD-ROM drive interface to PCs.

Key specifications include: THD+N of 0.0025% (-29dB, typ), signal to noise ratio of 110dB typ, 98dB typ dynamic range, 3.2Vp-p analog voltage output and eight times oversampling digital filter.

It is available in a 28-pin SOIC package, and operates from a single +5V power supply.

For further information circle 277 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone 008) 335 245.



Low power 12-bit ADC is fast

The CLC949 from Comlinear Corporation is a programmable, 12-bit A/D converter that consumes milliwatts of power and allows users to adjust internal bias levels to make simple speed/power tradeoffs. This new A/D consumes only 65mW at 5MB/s and 200mW at 20MS/s.

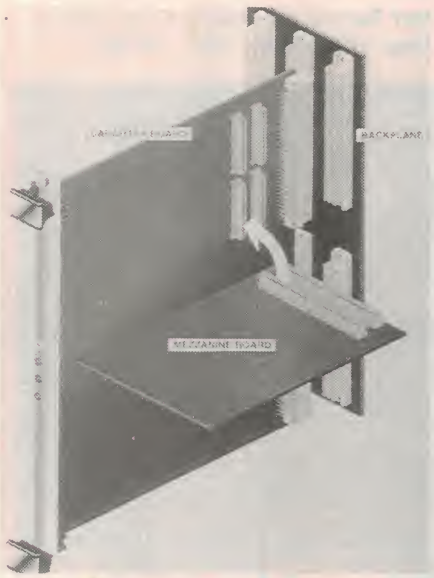
When set for 220mW of power, the CLC949 delivers a 20MS/s conversion rate, 65dB SNR and 72dB SFDR with a 9.9MHz analog input.

For further information circle 275 on the reader service coupon or contact Zatek, PO Box 397, West Ryde 2114; phone (02) 874 0122. ❖

NEW PRODUCTS

Stacking connectors support IEEE P1386

A new stacking connector system manufactured by Molex and available from Utilux supports the new IEEE P1386 mezzanine card standard, which contains the mechanical, electrical and logical details for adding standardised common, PCI and S-bus mezzanine cards to many types of systems.



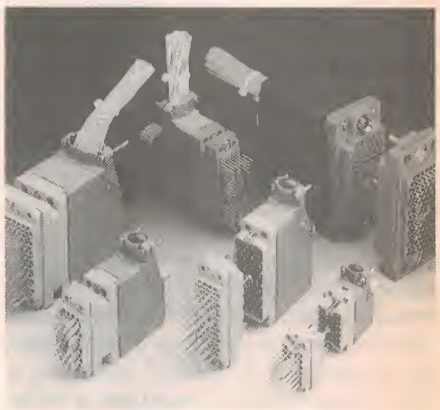
Applications for the 1.0mm pitch SMT board-to-board connector system include backplane type systems such as VMEbus, VXIbus and Futurebus; telecommunications, and PCs and workstations that require a standardised mezzanine scheme. It is also suitable for local area network (LAN) and wide area network (WAN) equipment.

The standard calls for 64 circuit connectors that can be used in combinations of up to four connectors for maximum design flexibility. For example, 32-bit PCI mezzanine cards would use two connectors to provide 128 circuits; a 64-bit card would use three connectors for 192 circuits. It is available in tubes or embossed tape packaging for use with automatic pick and place equipment.

For further information circle 243 on the reader service coupon or contact Utilux, PO Box 68, Kingsgrove 2208; phone (02) 50 0155.

Connectors with hermaphroditic contacts

The series 8016 rack and panel connectors from ELCO are I/O connectors,



that use a proprietary hermaphroditic contact principle.

The hermaphroditic Varicon contact has a fork-like design incorporating four large mating surfaces that are coined together to achieve exceptional hardness and smoothness. The mating surfaces are wedged together by the contact's spring like design and by the properties of the contact material. The contact has proved to be extremely reliable in a wide variety of applications. The connectors are available for soldering or wire wrapping, crimping or highly integrated miniature crimping.

Benchtop counter has RS-232 interface

The Thurlby Thandar TF830-ARC is a 1.3GHz counter timer with RS-232 serial interface. The instrument provides at least seven figures of accuracy per second of measuring time. Low frequencies can be measured to a resolution of 0.001 millihertz.

This high resolution is provided through a reciprocal frequency counting technique, whereby synchronised multiple period counting measurements are followed by computation of the reciprocal value (frequency), thus eliminating +/-1 input cycle errors typical of conventional frequency counters.

The instrument permits pulse width measurements from rising to falling edge, or vice versa. Other measurements include period, frequency ratio and event counting.

The TF830-ARC is suitable for ATE systems, as the RS-232 interface allows full front panel control, data transfer

and addressing, therefore permitting operation of two or more instruments from a single RS-232 computer port.

For further information circle 242 on the reader service coupon or contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066; phone (03) 419 9999.

The 8016 connectors have an actuating screw mechanism which allows easy fitting and removal, with a locking device which fixes the contacts. The insulator is designed to allow a positioning key and cover to be mounted to prevent incorrect fitting, and to protect the joint.

For further information circle 244 on the reader service coupon or contact M. Rutty & Co, 1/38 Leighton Place, Hornsby 2077; phone (02) 476 4066.

New connectors and switches

Dick Smith Electronics has added some interesting new connectors and switches to its wide range of electronic components.

The P-2279 is a handy BNC adaptor, providing two female and one male connector in a 'Y' configuration as an alternative to the more usual but often inconvenient 'T' configuration. It is provided with gold-plated inner contacts, and is very suitable for either instrumentation or data network cabling. The quoted price is $8.95.

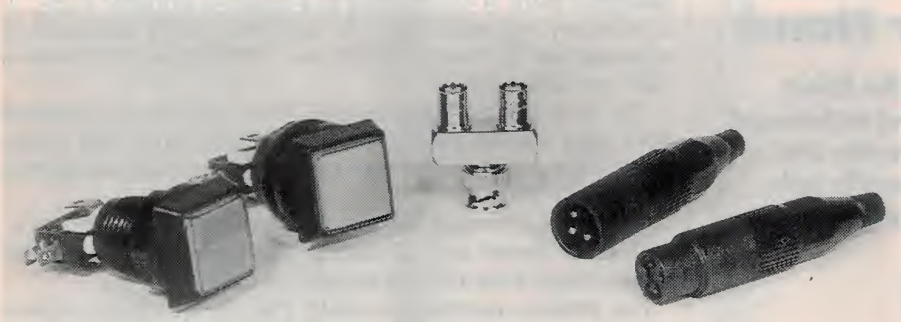
The P-7591 and P-7593 are 250V AC 10A rated SPDT microswitches, fitted with large illuminated pushbutton 'front ends'. The pushbuttons measure 25mm square in a 32mm square bezel, and are fitted with a red filter in the case of the P-7591, or a green filter in the P-7593. Both switches use a 12V incandescent lamp for illumination, and the pushbutton assembly mounts via a single round hole 25mm in diameter. A neoprene sealing washer and moulded mounting nut are included.

The microswitch contacts on the P-7591/3 are fitted with 4.8mm 'faston' connector lugs, while similar 6.5mm lugs are used for the illumination lamp connections. The P-7591 and P-7593 are very suitable for use on switchboards and control panels, and are priced at $9.95 each.

DSE is now also stocking the Alcatel AC3XP series of 3-way fully moulded AC connectors, which are compatible with the established XLR style of connector. Like the XLR range the new connectors offer rugged construction, positive latch-lock connection, firm cable clamping and a flexible rubber cable relief.

All three contacts in the P-1612 socket and P-1609 plug are of tinned phosphor-bronze and rated to carry up to 15A at voltages up to 133V RMS. They are recommended for use below 50V in domestic applications. Both connectors are easily assembled and are priced at $3.95 each.

All of these components are available from DSE retail outlets and dealers, or via mail order: phone 1-800 22 6610 or (02) 888 2105, or fax (02) 805 1986.



NEW PRODUCTS

35mW helium-neon laser

Melles Griot Lasers has introduced a 35mW helium neon laser to its existing range of laser systems.

The system comprises a separate laser head and power supply to allow integration into OEM designs. Both random polarisation and linear polarisation are available. Beam diameter is nominally 1.25mm with a divergence of 0.66mRad.

For further information circle 245 on the reader service coupon or contact Spectra-Physics, 26 Research Drive, Croydon 3136; phone (03) 761 5200.

GPS satellite simulator

The GPS-101 Satellite Simulator from US company IRF Systems is used to verify the operational integry of GPS system installations in aircraft, trains, cars, trucks, boats and handheld units. It can be used in a bench or portable mode, as it is battery operated. Up to 36 satellites can be simulated by adjusting the RF level (-85dBm to -145dBm) and the Doppler shift (+/-4kHz offset).

The unit has pre-programmed NAV data or user defined NAV data can be loaded via an RS-232C port. The coarse acquisition code is phase modulated with the selected satellite (SV1 to SV37).

A front panel keypad is used for function selection, field selection, LCD control and self-testing. The unit comes with an antenna/coupler accessory for installation testing.

For further information circle 250 on the reader service coupon or contact Vicom Australia, 4 Meaden Street, South Melbourne 3205; phone (03) 690 9399.

Ribbon cable crimping pliers

Until now, fitting insulation-displacement connectors (IDCs) to ribbon cables has required a relatively expensive press or makeshift and awkward use of a bench vyce.

However the job can now be done conveniently, reliably and at low cost using a new hand-held crimping tool available from Rod Irving Electronics.

The T13000 crimping tool uses a very sturdy all-steel construction, apart from soft plastic cushions on the handles and an adaptor piece for smaller IDC connectors. A double pivot and slot system ensures that the moving crimp anvil remains parallel to the fixed 'stand seat' on the other side, for correct operation. Both anvil and seat are 56mm long.

The stand seat itself fits 15.5mm wide IDC connectors, while the adaptor piece (which clips over the moving anvil) has slots for 6mm and 10mm wide connectors. The overall crimping distance varies from a maximum of 27.5mm without the adaptor piece, to a minimum of 6mm with it fitted and set to the 6mm-wide position. This allows it to be used to fit a wide range of IDC connectors.

The T13000 is available for $59.95 from all Rod Irving Electronics stores, or via mail order by phoning 1-800 33 5757 or (03) 543 7877, or fax (03) 543 8295.❖

Special Feature:

SMT, PCB's and Soldering

Integrated tinning system

Today's less aggressive 'no-clean' fluxes and solder creams and high lead count fine pitch components require assured solderability. The PREP-SET from Pace meets this demand by providing a fully integrated system for easily fluxing and tinning leads and wires, and dressing soldering tips.

The PREP-SET contains a unique set of three quick change, fast heating stainless steel pot-tips. Each pot-tip is shaped and sized to suit various applications and for operation between 305°C and 350°C.

The set also provides a stable 8.3 x 15.9cm base with fitted storage, including a sealed flux container, HandiPik component handling tool, and a dross cleaning tool. The HandiPik, with self-generating vacuum, is manufactured from static safe material.

Solder spillage is minimised by the unique containment lip on each solder bath, and the base has an additional containment ridge. A dross tray reduces contamination and mess. Heat shielding minimises the possibility of accidental burning, and the base remains cool during operation.

For further information circle 205 on the reader service coupon or contact Solder Static, Unit 14, 262 Miller Road, Villawood 2163; phone (02) 725 6211.

Solder station powers dual irons

Weller has released the DEC1001D dual system soldering station as part of its range of electronically controlled series of soldering stations.

The features of the new soldering station include: mil spec zero switching, proportional control, operating temperature control from 177°C to 454°C, a choice of three soldering tools from 20 watt to 48 watt, non-burn silicon rubber cords and a large range of tip styles and sizes. The station has Australian Electrical Authority approval and has a 12 months warranty.

The unit is assembled and serviced in Australia and has dual independent controls and outlets, for any two of the three Weller electronically controlled soldering irons.

Both outlets can be used simultaneously to give flexibility in tool use for a single operator. Alternatively, two operators can work independently from the station, reducing bench clutter. The station is sold as a power unit only, giving users a choice of soldering tools that can operate with the station.

For further information circle 202 on the reader service coupon or contact Cooper Tools, PO Box 366, Albury 2640; phone (060) 21 5511.

Repair kit for thru-hole, multilayer PCBs

A repair kit from Pace called CIR-KITS was developed for modifying and repairing lifted and damaged or missing lands, plated-thru holes and conductors on printed circuit assemblies.

The three different CIR-KIT models are Basic, Advanced and Master, to suit various levels of repair in the factory or the field. These models include combinations of 'straight trak', 'shaped trak', 'trak pad', DIP pad and edge connectors, each in a 'selector frame' with various sizes and finishes.

As well, a combination of tools is supplied with each kit.

For further information circle 204 on the reader service coupon or contact Solder Static, Unit 14, 262 Miller Road, Villawood 2163; phone (02) 725-6211.

Air source for fluid dispenser

Royel International has introduced a new product that provides a compressed air source for all brands of fluid dispensing units, including solder paste, solder flux, silver solder and other high viscosity materials.

The unit is a self-contained regulated air compressor with a capacity of 30 litres per minute at a pressure of 8kg/sq cm. It has a footprint of 170 x 200mm and operates from a 240V single phase supply. It connects to the dispenser with a two metre length of pressure hose.

The unit allows independent operation of Royel's recently introduced RT6550 surface mount circuit rework station. This station is claimed to bridge the gap from thru-hole soldering to surface mount soldering and repair work.

For further information circle 203 on

the reader service coupon or contact Royston Electronics, 27 Normanby Road, Notting Hill, 3168; phone (03) 432 5122.

Soldering station for leadlighting

The Weller WLC80D is a 240V variable control soldering station for leadlighting. The front panel adjustment gives an infinitely variable control from five watts to 80 watts. There are four iron plated soldering tips available for the iron.

The soldering station is in an attractive red housing, and features an 80W leadlight iron and 6mm iron plated tip for hobby or professional work. The station is Australian Electrical Safety Approved and is available from suppliers of Cooper tools.

For further information circle 206 on the reader service coupon or contact Cooper Tools, PO Box 366, Albury 2640; phone (060) 21 5511.

Surface mount rework station

Extending its range of 'Thermatic' rework stations supplied to the Australian Defence Services, Royel has now introduced a new specialised surface mount station. The station has electronic metering of solder paste as well as a temperature controlled hot air/gas jet handpiece, a surface mount removal tweezer, and a digital readout of the actual gas or tip temperature.

Royel claims that with selected optional heads and tips, all types of surface mount components, from ceramic chip capacitors to multi-lead quad packs can be replaced under strict process control. The handpieces, which include a small parts vacuum pickup quill, have static dissipative handles, making them ESD safe. The power unit, which measures 170 x 200mm, can also control thru-hole desoldering and pencil soldering tools, which can be purchased separately.

READER INFO NO. 33

READER INFO NO. 34

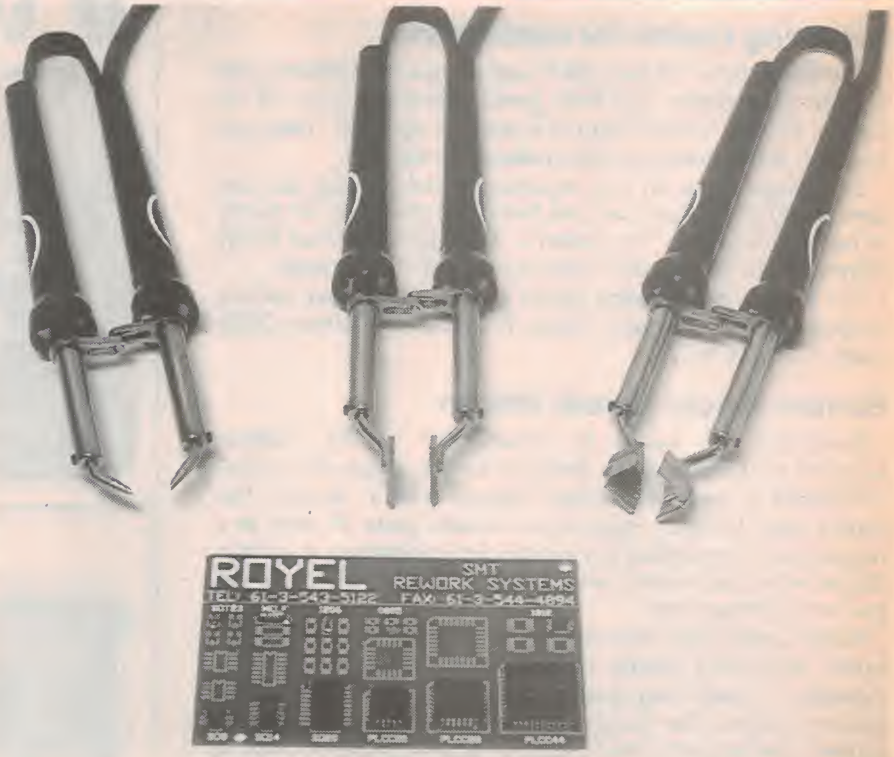
For further information circle 201 on the reader service coupon or contact Royston Electronics, 27 Normanby Road, Notting Hill, 3168; phone (03) 432 5122.

Precision SMD removal tweezers

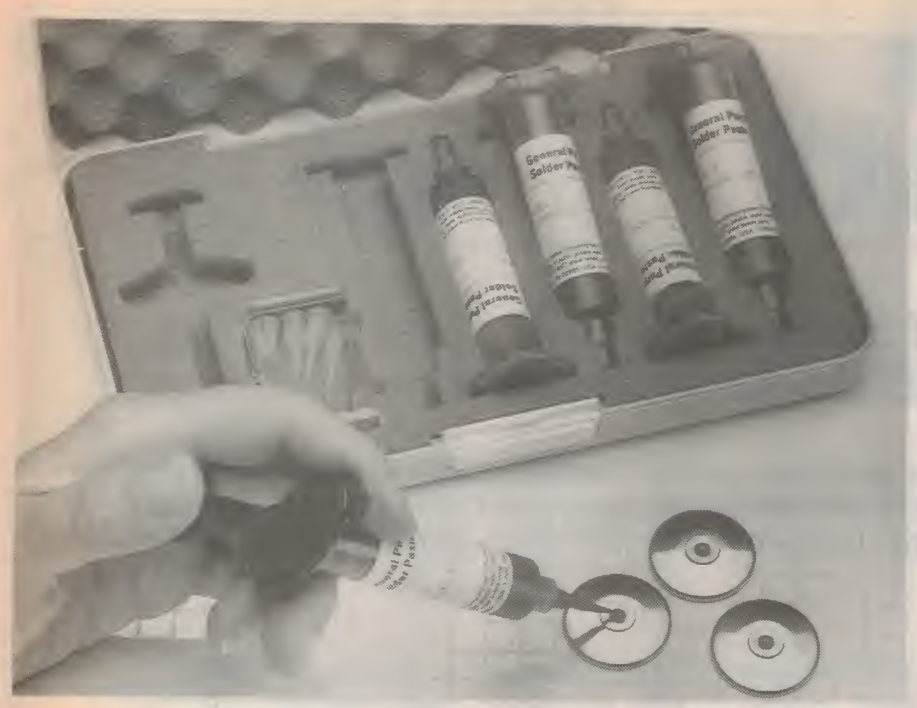
Royston Electronics has introduced several variations to the Royel surface mount removal tweezers. All tweezers are feedback temperature controlled and can be operated from any Royel analog or digital readout soldering and desoldering power unit.

The ESD safe tweezer (Cat. No. TW100), is a light weight precision tool (43 grams), held and operated between thum and forefinger for precision placement of the smallest chip component and able to handle the largest quad flatpack (PLCC) component. Long life tiplets, blade or bracket heads are easily and quickly replaced with an allen key provided with each tool.

Operating power is 50 watts and close tolerance temperature control is maintained through the N type thermocouple mounted at the end of one of the barrels.



For further information circle 239 on the reader service coupon or contact Royel International, PO Box 328, Mount Waverley 3149; phone (03) 543 5122.



Solder paste evaluation kit

To allow the evaluation of using homogenous solder paste instead of flux core solder wire, ESP is offering Kit-5, a kit containing five prepackaged barrels of solder, moulded dispensing tips and a reusable dispenser for precise solder applications.

Useful for electrical as well as mechanical applications, the kit includes two barrels each of 62SN/36Pb/2Ag and 63Sn/37Pb alloy. Each solder paste alloy, packed 35 grams per barrel is supplied with both an activated resin flux and a no-clean flux. Also included is a prepackaged barrel of the activated resin paste flux for desoldering evaluation.

For further information circle 238 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999. ❖

SPOTLIGHT ON SOFTWARE

Protel's Advanced Schematic 2.2 and Advanced PCB 2.6 for Windows

The latest versions of Protel's complementary pair of Windows-based schematic capture and PCB design packages offer significant enhancements over previous versions, and in many ways continue the tradition that has made this firm's CAD products so popular — especially in Australia.

by JIM ROWE

Despite its modest origins in Hobart, Tasmania, Protel Technology has become well known and highly regarded around the world for its electronics-orientated CAD products. The firm's DOS-based PCB design products *Autotrax* and *Easytrax* were really excellent, and rapidly became the most widely used products in Australia. Along with the schematic drawing or 'capture' package *Protel Schematic* they were also quite successful in both Europe and the USA, with sales in the latter market so strong that Protel was able to establish an ongoing facility in California.

Although the DOS-based products are still very widely used, especially in Australia, they have of course been superseded as far as Protel is concerned by its Windows-based products. There's now quite a family of these, many of which are designed for relatively high end users. However the two we're looking at here are the complementary *Advanced Schematic for Windows* version 2.2, the latest schematic capture package, and *Advanced PCB for Windows*, version 2.6. Both are intended for general electronics design work, with *Advanced PCB* essentially an enhanced Windows-based successor to *Autotrax*.

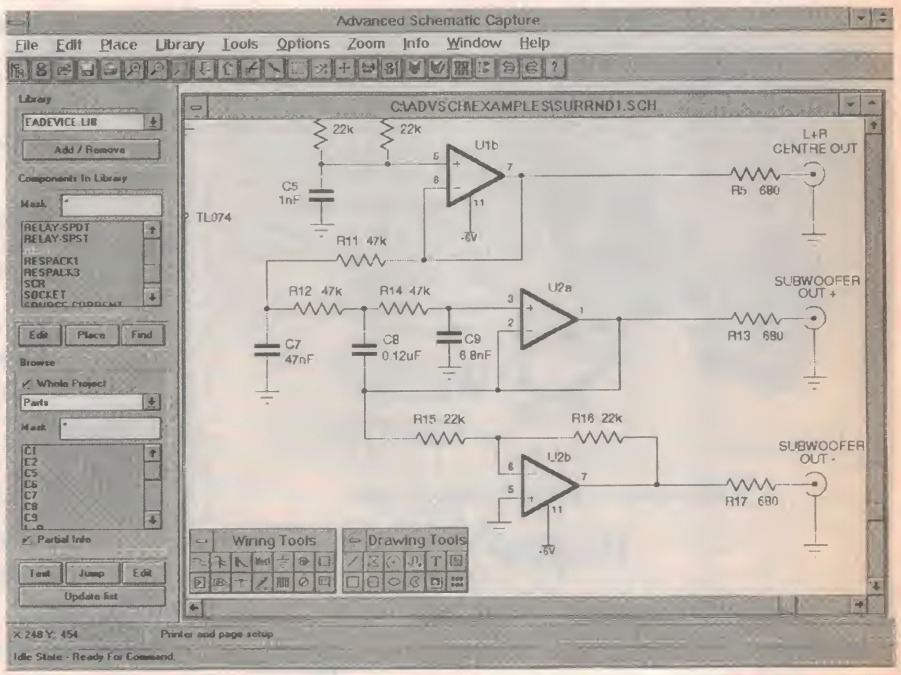
Advanced Schematic 2.2

Rob Evans actually reviewed the first version of *Advanced Schematic*, V1.0, in the August 1993 issue of *EA*. At the time he was quite impressed with its many enhancements over the original DOS package, noting that together with the latter's ease of use it offered both full vector-drawn symbols plus the inherent flexibility and power gained from its use of the Windows platform. Hassles with printer and graphics display management were now in the past, along with memory and disk file management.

Needless to say Protel's software engineers have improved the package quite significantly in the last 18 months, and the latest version includes literally hundreds of new editing features and enhancements. These include the ability to define your own drawing sheet templates and title blocks, additional netlist export formats, a comprehensive new font management system and expanded communications links to/from both *Advanced PCB* and other Windows applications.

The list of 'added extras' is in fact quite impressive, and covers virtually every area of program operation — from things like 'drag and drop' component moving and 'quick copying' of component attributes, to a text search and replace function.

There's also a 'cross probing' facility linking with *Advanced PCB*, user control over auto-panning and zooming, improved flexibility during file loading and saving, support for Windows' clipboard .CMF linking with other applications, the ability to load 32-bit OrCAD 386+ files, a memory and system resources monitor,



A screen dump showing the resources available when you're using Advanced Scehmatic 2.2. The component library browser is visible down the left hand side, with the wiring and drawing tool bars at lower centre.

and improved netlist for SPICE and EESOF simulators. In short, it's a much enhanced package, and Protel has clearly come a long, long way from the original DOS-based *Schematic*.

In order to try the new package out for this review, I installed it on two different machines: a 486DX-based 33MHz model with 8MB of RAM, at home, and my office 486DX2/66MHz model with 16MB of RAM. In both cases it installed very easily and quickly, without complications. Having it installed on both machines allowed me to use it fairly extensively over the last couple of months, and get a good idea of its capabilities.

By the way, the latest version of *Advanced Schematic* uses a software security code system rather than the original hardware 'dongle', making this kind of testing more practical.

The hard disk space required by *Advanced Schematic* depends on the installation options you choose, and varies between about 9MB and 30MB. I went for a fairly basic setup, without the military TTL device library or Xilinx interface, which used about 14MB.

Now the best way to test this kind of package is to 'use it in anger' — i.e., to produce *real* schematics that you need, not just browse through its facilities or try out a few simple examples. So that's exactly what I did. In fact the schematics in this month's Surround Sound Decoder article were produced using *Advanced Schematic*, as part of the exercise.

In order to be able to do this, I also had to make fairly extensive use of the accompanying *Schematic Library Editor* program, which is used to draw new component symbols, modify existing symbols and generally customise your component symbol libraries. As this is essentially a much-updated functional successor to the old DOS-based *SLM*, which was a bit hairy, I was interested in using it anyway. More about this shortly.

Once I had used *SLE* to produce a new component library with a reasonable number of symbols in our normal *EA* style, I was able to give *Advanced Schematic V2.2* a fairly good workout. And basically I too am now very impressed; this is certainly a most powerful and flexible schematic drawing package, with the facilities to achieve just about everything one could conceivably want for this work.

Of course its very power and flexibility tend to result in a fairly steep learning curve, and accordingly it takes a while before you're able to work efficiently. However on the whole I found the user interface and functions quite intuitive, and relatively easy to master. Once you've mastered them, you can produce schematics very quickly and conveniently.

Mind you, there are still a few puzzling and at times quite exasperating little quirks, in both *Advanced Schematic* and *Schematic Library Editor*. Here's some of those I found in *Advanced Schematic*:

- If you print your schematic with a text label still 'in focus' (i.e., highlighted) after some editing, it prints out with a little dashed line around it.
- If any of your component symbols use area fills (to fill in say capacitor 'bars'), with a monochrome printer these will only print out in 'Color Mode' — not in monochrome mode. But in Color mode, your sheet background must be stark white, or it will print on your monochrome printer as a shade of grey...
- Despite the program's quite good font management capabilities, the default font for all main component label text is Times Roman and this can't be customised by the user. If you prefer another font, like Helvetica, you have to use the global search and replace facility for every drawing you do...
- You also have to be very careful setting up your fonts, to avoid getting excessive kerning on the printout due to some sort of clash between the width tables for the screen and printer. Generally I found it safest to select the 'printer' version of the font for both.

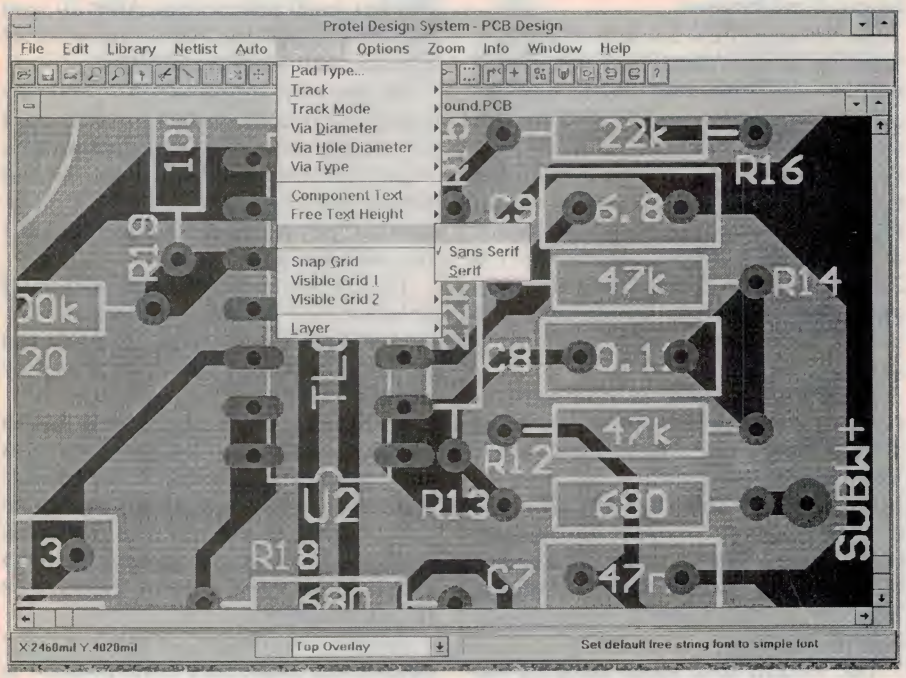
Schematic Library Editor also has its quirks, one of which I found especially frustrating. This occurs when you try to edit a component symbol, and try to select a particular line segment, arc or other primitive graphics element. As often as not, *SLE* seems to have a mind of its own and insists on selecting or 'focussing' not on the element *you* click on, but on another one nearby.

Frequently the only ways around this one seem to be to either delete the element(s) *SLE* DOES want to select, or move it/them away, until you CAN select the element you want to work on. Then of course you have to either draw or move back the other elements later — making the exercise not only very exasperating, but also somewhat longer than it should be.

Strangely enough there are also only four fixed line widths available for drawing component symbol elements — and two of these I'd describe as 'far too thin' and 'far too thick' respectively. Full user control over line width would be a big improvement...

Frankly, I'd suggest that whoever wrote this section of *SLE* be asked to go and study the drawing and editing functions of almost any version of *CorelDraw!*. I'm sure that anyone who has used *CorelDraw!* would agree with me that it's a heck of a lot more friendly, in this respect.

On the whole, though, there's no doubt that the *Advanced Schematic* package is an extremely powerful and



Another screen dump, this time in Advanced PCB 2.6. The 'current' pull down menu has been activated, and also the daughter menu for the free text font selection. Layer selection is via the pop up menu at bottom centre.

professional one, and a vast improvement over the old DOS package. If Protel can only fix those irritating little quirks, it'll be really outstanding.

By the way, *Advanced Schematic* will make a reasonably good attempt at importing files from the old DOS version, substituting new vector symbols for the old bitmap symbols if the drawing uses those from the original Protel device library. Otherwise you get the original bitmap symbols and have to replace them yourself.

Advanced PCB 2.6

When I began the testing for this review I was sent version 2.5 of *Advanced PCB*, and used this for a fair bit of my trial. But as the V2.6 upgrade was about to be released just before this issue would be published, Protel very kindly sent me an advance copy so I could use it to bring the review up to date.

As you might expect, *Advanced PCB* is a very much enhanced successor to *Autotrax*, ported to the Windows environment and again offering all of the advantages this brings in terms of user interface and platform support. (Plus one fairly significant drawback, but more about this shortly.)

The basic PCB design 'engine' is now a 32-bit one, and can generate both through-hole and SMD designs of up to 16 layers, plus four mid-layer power planes. Four mechanical drawing layers are included. Boards can be up to 254cm square (100" x 100"), while rated placement accuracy is +/- 0.0005 mils (thou) on the imperial grid. You can toggle between imperial and metric grids at any time.

Advanced PCB allows you to not only input netlists from *Advanced Schematic* and input/output Gerber files, plus producing N/C drilling files, but also provides for Gerber batch file loading. It also provides extensive global change capabilities, auto placement and a line probe autorouter. As before it will also generate reports such as BOM (Bill of Materials), pick and place, and ECO (Engineering Change Order) reports, plus back annotation files.

An *Advanced Place* option adds high performance global auto component placement tools, another *Advanced Route* option adds a high performance 'rip up and retry' maze autorouter, while the *Advanced SB Route* option adds a shape-based 'gridless' autorouter.

Compared with *Autotrax*, there are a host of new and/or enhanced facilities for component and/or track placement. For example components and graphic elements can now be rotated in .001° increments, instead of the old 90° steps. Components can also be edited by double-clicking on them. There are now multiple type fonts available, and there's also solid or lattice polygon plane fills which 'pour' automatically into or around designated areas.

Other features include a repeating Array Placement facility (both linear and circular arrays), multiple-level undo and redo commands, the ability to import files from *Autotrax*, *PADS-PCB*, *PADS2000* (.ASC), *PCAD* (PDIF 5/6 format) or *Tango Series II*. It can also import files from *AutoCAD*, in .DXF format. In short, then, it's again a very powerful package and in many ways a far cry from *Autotrax*.

As *Advanced PCB 2.6* uses a hardware security device 'dongle', I installed it only on my home 486/33MHz machine and did my testing on this machine. Installation of the first V2.5 was quite straightforward and without hassles, but there were troubles more recently when I tried to install the V2.6 upgrade. Instead of replacing the original *Advanced PCB 2.5* icons in the Protel Design System group, the Setup utility simply installed a second set of icons — absolutely identical to the first!

Needless to say Windows became rather confused, and trying to run either version produced a crash. I had to delete all of the *Advanced PCB* icons, wipe all of its programs from the hard disk and re-install version 2.6 again from scratch before things worked again. (Puzzlingly, though, the icon still says 'Advanced PCB 2.5', even though the program itself says it's V2.6...)

The overall disk space used by *Advanced PCB 2.6* after installation is about 4.7MB, so it's quite compact by modern standards. Before and after the upgrade kerfufle, I found V2.5/2.6 quite easy to use. For anyone who has used *Autotrax* for a long time it has a lot of familiar features, translated of course into the Windows environment.

I tried both producing new board designs, and editing existing *Autotrax* designs using *Advanced PCB*, and generally struck few problems worth noting here. Version 2.5 turned out to have a curious bug, wherein it wouldn't print the holes in circular pads (only those in square, oblong or hexagonal pads!), but this problem has thankfully been fixed in V2.6.

My only real gripe with *Advanced PCB* is the drawback I alluded to earlier. The one negative aspect of having this kind of package ported across to the Windows environment is that it's *slow* — especially if you're used to *Autotrax*.

Autotrax mightn't have as many bells and whistles as the new one, but it's certainly FAST — even on an old 12MHz 286 machine. It's been so fast, I guess, that Protel kind of spoilt us...

The problem with *Advanced PCB* is that because it has to run in Windows' leaden boots, even on my 33MHz 486 with 8MB of RAM it's still noticeably slower than *Autotrax*, in important areas like screen redrawing. I gather that you have to run it on a 66MHz 486DX2 or better before it starts to run at the kind of speed we *Autotrax* users are all used to.

Still, if you're designing really complicated boards, where you do need all of those nice new bells and whistles, I guess this is a small price to pay. After all, you also need a 66MHz '486 to run a lot of the other new software, anyway.

By the way, *Advanced PCB* and *Advanced Schematic* each come with a set of comprehensive user manuals, somewhat improved on those for the earlier DOS packages. Like most Windows applications they also have on-line help facilities.

The quoted retail price for *Advanced Schematic 2.2* is $995, while that for *Advanced PCB 2.6* is $2795. The two can be purchased together as Productivity Pack 2, for $3595.

A 'Basic' version of the PCB design package is also available, with only a pad-to-pad router, for $995. An upgrade from *Advanced Schematic 1.0* to version 2.2 is $195, while users of *Advanced PCB 1.12* can upgrade to version 2.6 for $495. All registered users receive free technical support.

Further information on these and the other Protel electronics CAD products is available from Protel Technology at GPO Box 204, Hobart 7001; phone (002) 73 0100, or fax (002) 73 0944. ❖

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Dynalink MODEMS

READER INFO NO. 40

Silicon Valley NEWSLETTER

New UV lithography reaches down to 0.1um

Researchers at Sandia National Laboratories and AT&T Bell Labs have developed a laboratory version of a so-called 'extreme ultraviolet light' lithography tool that could be used to print circuits on chips five times smaller than the current technology.

Richard Stulen, a researcher at Sandia's federal laboratory in Livermore, said the tool has shown the ability to create circuits with features as small as 0.1 micron in length, about one-thousandth the width of a human hair. The technology would further extend the life of traditional optical light sources for etching circuits into wafer surfaces.

Until recently it was believed that the generation of 0.3-micron etching tools would be the last before the industry would have to switch to X-rays or other technologies under development.

Stulen said his team aims to finish research in 1996, develop a single working machine by 1998 and create a mainstream tool by 2007.

The development of the extreme ultraviolet lithography technology could prove invaluable to the industry's ability to continue forward. One of the greatest fears in the industry is that new technologies, such as X-ray lithography, will either not be ready in time to assume the role of mainstream manufacturing technique when the industry needs it in the next five to 10 years, or that these tools and the retooling of the industry would be prohibitively expensive.

"There is a real question now about whether the tools can be built cheap enough", said Richard Freeman, head of advanced lithography research at AT&T Bell Labs. "There is no reason to expect that electronics is different from other industries that have hit the technological wall, such as airplanes."

The Sandia project has been funded by the US Department of Energy and the Pentagon's Advanced Research Projects Agency. Also taking part in the project are Lawrence Livermore National Laboratory, Intel and Advanced Micro Devices.

Stulen estimates it could take US$300 million to $500 million to bring the technology to market, making it too expensive for any single company.

The world's largest chip maker put up the world's largest banner at the world's largest computer show (Comdex). It measured about 3ft wide, by a football field long. But the Nevada desert winds quickly blew the megasign to megabits.

Hitachi, NEC show gigabit DRAM

Hitachi Ltd and NEC announced separately prototypes of their gigabit DRAM memory chips, at the International Solid State Conference (ISSC) in San Francisco. A single chip would be capable of storing the equivalent of 10 copies of the complete works of Shakespeare, four hours of compact-disc quality sound, or 15 minutes of video images.

The chips are not expected to reach the market in volume until after the turn of the century. Early engineering evaluation samples will become available to potential users in 1998.

The most advanced chip in widespread use now can store 16 megabits of memory. Several manufacturers, including Samsung are close to bringing 64Mb lines on line with 256Mb chips scheduled for production by 1998.

One indication of the amount of work still lying ahead of NEC and Hitachi is that NEC's chip is still a specialised type of DRAM for filing applications. It is not yet able to provide rapid random access to items of information stored in different places on the chip.

Sony OnLine service on WWW

Sony of America plans to launch its own online computer service, to be known as 'Sony OnLine' in September. The service will offer PC-based consumers access to such things as music videos, computer games and software, and an electronics products catalog.

Sony executives said the service will be available over the Internet computer network. Sony OnLine will be located on the World Wide Web, an area on the Internet that supports multimedia documents including audio, text and full-motion video and graphics.

Besides a broad range of consumer electronics products, Sony has substantial interests in the entertainment industry. It owns the Columbia film studios in Hollywood, dozens of movie theatre complexes across the United States, as well as several music studios,

and the company has long-term contracts with popular artists including Michael Jackson.

"Sony OnLine brings together all of Sony's product, programming and technology in one exciting venue", said Mitchell Cannold, president of Sony New Technologies. "Sony now can communicate directly with all of our customers and effectively convey the extraordinary breadth of Sony's software and hardware operations."

Among the different services to be offered will be:

- Sony Music Entertainment will provide information on many of Sony's artists, album news, biographies and concert dates — plus music video clips and sound samples.
- Sony Electronic Publishing, Sony's interactive division, will offer access to demos from current and upcoming video game and computer software releases.
- Sony Theaters will offer an overview of the company's theatre operations, including a state-by-state listing of its theatres.
- A yet-unnamed service will offer a catalog and shopping service featuring merchandise linked to TV shows, films and music artists.
- Sony Pictures Entertainment will provide users with highlights of the company's films. Consumers will be able to get information about new movies from Columbia Pictures, TriStar Pictures, Sony Pictures Classics and Triumph Films.

Comdex sold to Japanese entrepreneur

Comdex, America's annual premier showcase event of the personal computer industry, has been sold for a whopping US$800 million to Softbank, Japan's leading distributor of software and publisher of computer magazines.

Softbank is owned by Masayoshi Son, who at 37 has become one of Japan's most visible young entrepreneurs. The sale follows another US$202 million deal completed last fall, in which Softbank acquired the trade show business from the Ziff-Davis publishing group.

Comdex has been the property of the Interface Group and was the main event in the company's series of 17 trade shows, including Spring Comdex, Uniforum, and Windows World — shows that also have localised editions held in various countries world wide.

The Interface Group grossed about US$150 million from the trade show business. Comdex, which attracts some 200,000 visitors and more than 2000 exhibitors at the annual event in Las Vegas, was said to be generating tens of millions of dollars in annual profits.

Industry analysts, however, questioned whether the Japanese company may have paid too much for the privilege of owning Comdex. The show has already grown to such proportions that it will be very difficult to make it even bigger. Despite plans for more exhibit space, there simply aren't enough hotel rooms available to accommodate additional visitors. Already the show consumes every available bed space within a 120-mile radius.

New Intel micro includes memory

Intel has unveiled details of its next-generation P6 microprocessor, a 5.5-million transistor design which Intel hopes will set the standard for the next generation of desktop computing. But unlike previous generations, the P6 may not be the runaway success the Santa Clara chip maker has been used to.

For a start, the chip is huge. While Intel engineers were able to squeeze 5.5 million basic building blocks into the same space as the Pentium's 3.1 million transistors, the chip's overall design — which includes a second chip in the same module — makes the package about the size of a credit card. With that configuration, the P6 will be about four times larger and four times more costly to produce than a comparable PowerPC chips from Motorola. And the higher cost will ensure the chip will remain outside the realm of the average PC users for some time, as other chips will offer far better price/performance ratios.

The P6 will cost around US$1500 in the initial stages of volume production, about three times the cost of the PowerPC 604.

Secondly, there are questions about the performance improvement of the P6. While Intel claims that the chip will be able to crunch numbers at twice the speed of a Pentium, or about 200 million calculations per second, that only brings the P6 up to par with the PowerPC 604, which is already shipping to customers.

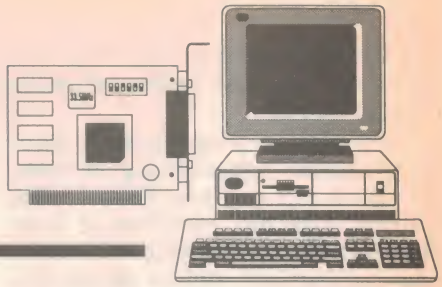
Also, a significant part of the P6's performance improvement is due to the placement of the secondary memory chip in the same package. And while the CISC-based P6 will be able to keep up with the RISC-based PowerPC 604, Motorola will likely have yet another upgrade of the PowerPC family on the market by the time the P6 systems will hit store shelves in volume.

These 'handicaps' could prove to be the opportunity IBM, Apple and the growing group of Macintosh clone manufacturers have been hoping for. By the middle of 1996, when Apple is scheduled to release its next-generation operating system, the Macintosh side of the PC field will be a full generation ahead of the PC side, both in terms of CPU performance and cost — as well as in operating systems, assuming Windows 95 will be available.

The development of the P6 involved about 200 people working in Hillsboro, Oregon since 1990. "It might be a stretch to say it was like the Manhattan Project", said Robert Colwell, one of P6's senior architects, referring to the development of the first atom bomb. "We were not working under wartime conditions. But I'd say it was definitely a marathon." ❖

Comdex also featured the world's longest taxi cab waiting lines, with many visitors waiting for up to two hours for a cab back to hotels not serviced by the show's shuttle buses.

Computer News and New Products

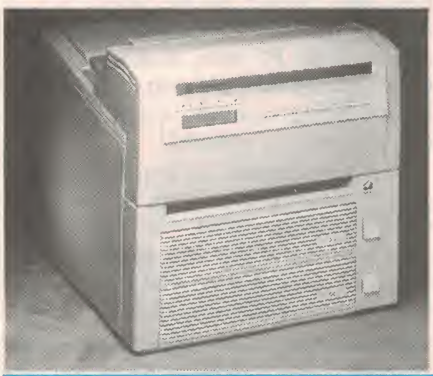


PostScript laser with PCL5 emulation

The LZR 895 from Dataproducts is an Adobe PostScript level 2 laser printer with PCL5 emulation. It features dual input bins for uninterrupted network printing, a high speed RISC processor and 600 x 600dpi resolution with edge smoothing technology for crisp images and smooth character edges.

The printer includes 3MB of memory (expandable to 19MB) with Adobe Memory Booster, which more than doubles the printer's effective memory — allowing the LZR 895 to deliver 6MB of performance with only 3MB of actual memory.

The LZR 895 is compatible with Windows, DOS and Macintosh applications, via a high speed bidirectional parallel and Appletalk interface. Automatic port switching allows each interface port, including the optional serial port, to remain active when the LZR 895 is connected to more than one computer. The printer also has a multi-protocol internal network interface which will simultaneously support most standard network protocols.

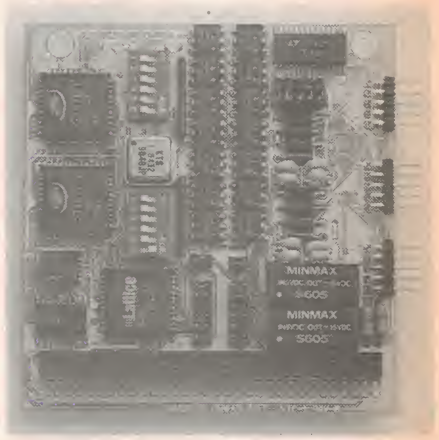


The printer has an estimated running cost (excluding paper costs) of under two cents per page (based on retail pricing), claimed to be around half that of competitive products. The RRP is $2757 (including tax) and the printer will be available through all Dataproducts' authorised resellers.

For further information circle 161 on the reader service coupon or contact Dataproducts, Unit 2, 10 Rodborough Road, Frenchs Forest, 2086; phone (02) 451 3533.

PC/104 module

The PCM-3610 is a PC/104 compatible module that offers high speed, isolated RS-232, RS-422 and RS-485 communication. The module provides two independent ports, accessed through male DB-9 connectors. One port supports RS-232 and RS-422/485, while the other supports RS422/485. An onboard 16C550 UART and 16-byte FIFO buffer enable high-speed communication at up to 115,200 bps. The module is also fully compatible with normal low-speed serial interfaces.



Programs written for half-duplex RS-232 can be used for RS-485 communication without modification because of special circuits on the PCM-3610 which sense the direction of incoming data and switch the transmission direction accordingly. This feature allows communication over just two wires and lets users easily change from RS-232 to RS-485.

The PCM-3610 supports I/O base addresses from 200H to 3F8H and interrupts 3 to 7 and 9. Optical isolation prevents ground loops and increases reliability in noisy environments. Additional surge protection on the transmit and receive lines minimises damage to devices connected to these lines.

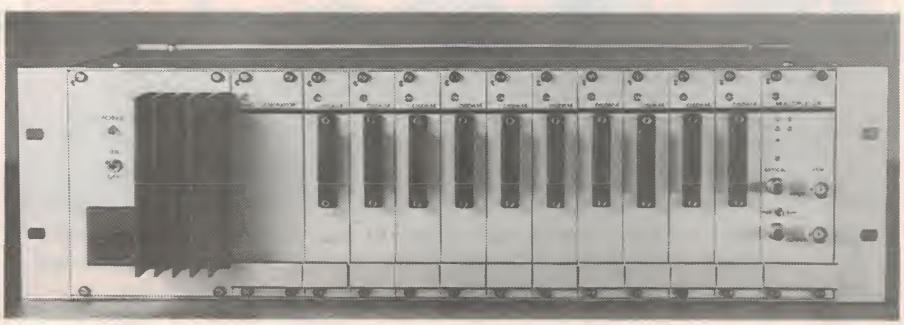
For further information circle 164 on the reader service coupon or contact Priority Electronics, Suite 4 and 5, 23-25 Melrose St. Sandringham, 3191; phone (03) 521 0266.

Fibre optic modem

The OSD600 from Optical Systems Design is a PCM primary multiplexer/fibre optic modem designed for large campus and industrial environments. The OSD600 is a modular system that provides a wide range of interfaces commonly used in such situations. Its line interface is configurable for coaxial cable, optical fibre or a combination.

Currently available user interfaces include: two-wire subscriber and exchange lines, four-wire audio card with E and M lead signalling, RS232/RS422 data and industrial party/paging. The unit can be supplied to work with either single-mode or multi-mode fibre.

For further information circle 162 on the reader service coupon or contact Optical Systems Design, PO Box 891, Mona Vale, 2103; phone (02) 913 8540.



PADS PCB special offer

GEC Electronics Division, Australian distributors for PADS Software, has announced a special promotion for existing P-CAD PCB users to enable them to purchase PADS PCB design software at half price.

This promotion has resulted from the uncertainty surrounding the P-CAD PCB layout tool following its purchase by Accel Technologies from Altium. Accel's

president, Walt Foley, stated that acquiring P-CAD's user base, and not its technology, was his primary motivation for the purchase. Regarding P-CAD, he said "It seemed we could blend our technology with their user base and history into a win-win situation for everyone".

The offer is: purchase PADS-Perform by May 31 1995, and receive 50% off the base PADS-Perform and any options needed to match the functionality of the P-CAD system being used. The offer includes one full year of PADS maintenance for free and an automatic, free upgrade to PowerPCB when this product is released.

Further, by special arrangement with Router Solutions, a P-CAD to PADS translator is available for A$500 to P-CAD users who purchase a Perform system. PADS also have special offers in routing technology from Cooper and Chyan Technologies and CAE tools from Viewlogic.

For further information circle 163 on the reader service coupon or contact GEC Electronics Locked Bag 29, PO Rydalmere 2116; phone (02) 638 1888.

GPIB interface for PC/104

National Instruments has announced a low cost, high performance IEEE 488 interface module for embedded PCs with PC/104 expansion.

The PC/104-GPIB is fully hardware and software compatible with the company's AT-GPIB/TNT plug-in IEEE 488.2 interface. It features a patented HS488 high speed mode for GPIB transfers up to 1.6MB/s. An embedded PC equipped with the PC/104-GPIB becomes a high performance IEEE 488.2 controller able to monitor, control and communicate with thousands of GPIB-based engineering, scientific, or medical instruments and graphics equipment.

The interface features the company's TNT4882C ASIC, and performs the basic talker, listener and controller functions required by all versions of the IEEE 488 standard.

For further information circle 165 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 879 9422.

Data acquisition module for notebooks

The WaveBook/512 is a DSP based, 12-bit, 1MS/s portable data acquisition add-on for notebook and desktop PCs. The device is an eight channel instrument specifically designed for applications that

require high resolution and high speed signal capture, such as engine strain testing, multi-channel acoustical testing, mechanical integrity testing and destructive testing. The unit has eight digital inputs, readable at up to 1MB/s, and is expandable up to 72 analog channels via an optional eight channel expansion module.

The module operates from either AC or DC power, and can be used in portable, field, or benchtop applications. It connects to a notebook PC via the enhanced parallel port (EPP) or an optional PCMCIA card interface.

Connection to a desktop PC is via the EPP port or an optional ISA plug-in card interface.

The WaveBook/512 includes Windows set-up and data acquisition software, comprehensive programming language drivers and drivers for third party graphical acquisition and analysis packages.

For further information circle 169 on the reader service coupon or contact Scientific Devices, 2 Jacks Road, South Oakleigh 3167; phone (03) 579 3622.

2.5" disk drive

Hitachi has introduced a family of 2.5" disk drives claimed to have the industry's highest available storage capacity in that format. They are intended for the OEM and after-sales notebook and sub-notebook upgrade markets. Model DK221A-34 has a 340MB capacity and the DK211A-51 a 540MB capacity. The company will soon be releasing new models with up to 1.08GB capacity.

The drives are available in two height sizes of 12.5mm or 19mm, depending on capacity. The high capacity is achieved by glass platters and a special head disk assembly and thin-film head technology. All drives in the 2.5" range have an average seek time of 12 milliseconds and a fast ATA interface.

For portable computing applications, the drives have an operating shock resistance of 100 gravities (non-operating shock resistance is 150G). Current consumption for both seek and read/write operations is between 400 to 600mA and is 260mA for idle and 10mA for sleep operations.

For further information circle 168 on the reader service coupon or contact Bernhard Kotarski at Hitachi Australia, Level 4, 73 Miller Street, North Sydney; phone (02) 929 8788.

Miniature smart card holder

Smart cards are used to improve security, carry information and give positive user identification. For example, the GSM telephone system, the digital telephone network standard adopted in Europe and expanding around the world, depends on the use of smart cards for positive subscriber identification. These subscriber identity modules, or SIM cards, contain the user's identification, individual telephone number, billing information, and allow access to many features available on the GSM network. The current trend toward pocket size phones has led to miniature SIM cards measuring 15 x 25mm.

Molex has introduced a new SIM card holder for use with these miniature cards. The mini-SIM card is placed in a Molex carrier and the carrier with card slides into a slot in the case of the phone, and locks into the holder.

For further information circle 166 on the reader service coupon or contact Utilux, PO Box 68, Kingsgrove 2208; phone (02) 50 0155. ❖

PCMCIA I/O kit

Molex has released a complete PCMCIA Type II I/O card kit for applications such as fax/modem, LAN etc. The 89073 kit includes a 68-circuit receptacle, 15-circuit I/O header, a 15 circuit fully shielded I/O cable assembly, a frame with four pre-assembled EMI clips and two metal covers for the I/O card. The overall profile height of the card kit system is 5mm.

The 68-circuit receptacle for PCMCIA mating interface is made of PSS UL94V-O material with titanium copper terminals, and the 15-circuit I/O header has a built in polarisation key. Both the receptacle and header have a mating life cycle of up to 10,000 times. EMI shielding is provided by four independent gold plated clips pre-assembled to the frame.

For further information circle 167 on the reader service coupon or contact Utilux, PO Box 68, Kingsgrove 2208; phone (02) 50 0155.

Your Complete Guide To The Huge Range of CONNECTORS from Geoff Wood (Part 1)

Following the popularity of our Semiconductor Listing we're listing all our connectors over the next couple of months – *just to show you how comprehensive our range is.* We suggest you photocopy or save this page for future reference!

ALLIGATORS

AC26.B	26mm Black Allig.Clip	$0.30
AC26.R	26mm Red Allig.Clip	$0.30
AC32.B	32mm Black Allig.Clip	$0.35
AC32.R	32mm Red Allig.Clip	$0.35
AC34.B	34mm Blk Allig. Clip	$0.40
AC34.R	34mm Red Allig. Clip	$0.40
AC65.B	65mm Black Allig.Clip	$0.55
AC65.R	65mm Red Allig.Clip	$0.55

BNC

BNC1	RG58 5.3mm	$3.05
BNC1-R/A	Right Angle BNC Crimp	$12.40
BNC1CT	BNC Crimp Plg	$2.45
BNC1ST	COAX Plg Screw/Crimp	$3.30
BNC1TT	BNC Twist on Plg	$3.80
BNC2	BNC Panel Skt	$2.30
BNC3	3 Female Tee	$7.15
BNC4	BNC Coupler	$3.45
BNC6	2 Female, 1 Male Tee	$7.15
BNC8	Y Shape 1 Plug 2 Socket	$10.95
BNC9	R/A Socket to Plug	$5.05
BNC10	RG59 6.3mm	$2.80
BNC12	BNC Insltd Chassis Skt	$3.05
BNC13	RG58 Crimp Chassis Skt	$3.45
BNC-TERM-50ohm	BNC Terminator	$2.95

BANANA

BP4.B	4mm Blk Banana Plg	$0.80
BP4.R	4mm Red Banana Plg	$0.90
BP4L.B	4mm Banana Plg w/Link	$1.60
BP4L.R	4mm Banana Plg W/Link	$1.60
BP4M.B	4mm Black Banana Plg	$1.90
BP4M.R	4mm Red Banana Plug	$1.90
BP4S.B	4mm Stkbl Banana Plg	$2.25
BP4S.R	4mm Stkbl Banana Plg	$2.25
BS4.B	4mm Chassis Skt	$0.65
BS4.R	4mm Chassis Skt	$0.65

AUDIO

MONO

C25.B	2.5mm Inline Skt	$1.10
C25.R	2.5mm Inline Skt	$1.00
C35.B	3.5mm Inline Skt	$1.00
C65.B	6.35mm Inline Skt	$1.50
C65.R	6.35mm Inline Skt	$1.50
C65.M	6.35mm Metal Skt	$2.65
J25	2.5mm Mono Skt	$1.30
J35	3.5mm Mono Chassis Skt	$1.30
J35C	3.5mm Chassis Skt	$0.70
J35S	3.5mm Mono Closed Skt	$1.30
J65	6.35mm Mono Clsd Skt	$1.65
P25.B	2.5mm Plg	$0.75
P25.R	2.5mm Phone Plg	$0.75
P35.B	3.5mm Plg	$0.75
P35M	3.5mm Metal Plg	$1.25
P35P	3.5mm Phone Plg	$0.60
P35.R	3.5mm Phone Plg	$0.75
P65.B	6.35mm Mono Phone Plg	$1.10
P65M	6.5mm Metal Plg	$1.80
P65.R	6.35mm Mono Plg	$1.10
P65MA	6.35 Mono Mtl Plg	$2.05
P65P	6.5mm Phone Plg	$1.10

STEREO

CS35	3.5mm Stereo Inline Skt	$1.60
CS65.B	6.35mm Stereo Skt-Plastic	$1.55
CS65.M	6.35mm Stereo Mtl Skt	$2.85
CS65.R	6.35mm Stereo Inln Skt	$1.55
JS35	3.5mm Stereo Closed Skt	$1.30
JS65	6.5mm Stereo Clsd Skt	$2.45
JS65.C	6.35mm Stereo Dbl Close	$2.75
PS25	2.5mm Stereo Plg	$2.25
PS35.B	3.5mm Stereo Plg	$1.25
PS35M	3.5mm Stero Metal Plg	$1.70
PS35.R	3.5mm Stereo Plg	$1.25
PS65.B	6.35mm Mono Phone Plg	$1.55
PS65M	6.35mm Stereo Plg	$2.30
PS65.P	6.35mm Stereo Phone Plg	$1.55

CANNON

CAN-AXR-3-11	3 Pin Inline Fem Plg	$7.85
CAN-AXR-3-11-B	Cannon Socket	$7.90
CAN-AXR-3-12	3 Pin Inline Male Plg	$7.30
CAN-AXR-3-21	Female Chassis Skt	$9.50
CAN-AXR-3-22	Cannon Skt	$6.55
CAN-AXR-3-31	3 Pin Inline Fem Plg	$8.80
CAN-AXR-3-32	3 Pin M Chassis Skt	$5.95
CAN-AXR-3-34	Male Chassis Skt	$6.80
CAN-AXR-4-11	4 Pin Inline Fem Plg	$12.95
CAN-AXR-4-12	Cannon Plug	$9.85
CAN-AXR-4-31	4 Pin Fem Chas Skt	$13.30
CAN-AXR-4-34	Male Chassis Skt	$7.70
CAN-AXR-5-11	5 Pin Inline F. Plg	$18.95
CAN-AXR-5-12	5 Pin Inline M. Plug	$11.95
CAN-AXR-5-31	5 Pin F. Chassis Skt	$18.15
CAN-AXR-5-34	Male Chassis Skt	$11.05
CAN-AXR-LNE-11	3 P. 250V F. Plg	$16.95
CAN-AXR-LNE-12	3 P. 250V M. Plg	$16.95
CAN-AXR-LNE-31	3 P. 250V F. Skt	$12.90
CAN-AXR-LNE-32	3 P. 250V M. Skt	$12.00
CAN-AXR-JNR-FML	3 Pin AXR Joiner F/F	$9.95
CAN-AXR-JNR-MALE	3 Pin AXR Joiner M/M	$8.95

CENTRONICS

SOLDER

CENT-14-PLG	Centronics Cable Plg	$4.35
CENT-14-SKT	Centronics Cable Skt	$6.35
CENT-24-PLG	Centronics Cable Plg	$5.95
CENT-24-SKT	Centronics Cable Skt	$12.00
CENT-36-PLG	Centronics Cable Plg	$3.35
CENT-36-SKT	Centronics Cable Skt	$5.35
CENT-50-PLG	Centronics Cable Plg	$8.40
CENT-50-SKT	Centronics Cable Skt	$10.85

CENTRONICS-IDC

IDC-CENT-24-PLG	Centr. IDC Plg	$8.40
IDC-CENT-24-SKT	Centr. IDC Skt	$7.90
IDC-CENT-36-PLG	Centr. IDC Plg	$6.55
IDC-CENT-36-SKT	Centr. IDC Skt	$6.00
IDC-CENT-50-PLG	Centr. IDC Plg	$12.55
IDC-CENT-50-SKT	Centr. IDC Skt	$10.75

DC PLUGS & SOCKETS

DC10	1mm DC Plug-SANYO	$1.30
DC13	1.3mm DC Plug-SANYO/AWA	$1.30
DC16	1.6mm DC Plg	$1.20
DC21	2.1mm DC Plg	$1.20
DC25	2.5mm DC Plg	$1.20
DC31	3.1mm Plug-JVC	$1.30
DJ21	2.1mm DC Skt	$1.10
DJ21C	2.1mm Chassis Skt	$2.25
DJ21P	2.1mm PCB Mount Skt	$0.95
DJ25	2.5mm DC Skt	$1.10
DJ25P	2.5mm PCB Mount Skt	$0.95

DIN PLUGS & SOCKETS

DIN-JD2	2 Pin DIN Skt	$0.70
DIN-JD3	3 Pin Panel Mount Skt	$1.00
DIN-JD4	4 Pin Panel Mount Skt	$1.20
DIN-JD5	5 Pin DIN Chassis Skt	$1.40
DIN-JD5A	5 Pin Domino Panel Skt	$1.35
DIN-JD6	6 Pin Panel Mount Skt	$1.50
DIN-JD7	7 Pin DIN Metal Skt	$1.55
DIN-JD8	8 Pin 270d DIN Mtl Skt	$1.70
DIN-JD8A	8 Pin DIN Panel Skt	$1.65
DIN-PD2	2 Pin DIN Plg	$0.80
DIN-PD3	3 Pin DIN Plg	$1.00
DIN-PD4	4 Pin DIN Plg	$1.05
DIN-PD5	5 Pin DIN Plg 180 Deg	$1.00
DIN-PD5B	5 Pin DIN Plg 240 Deg	$1.10
DIN-PD5M	5 Pin DIN Plg	$5.45
DIN-PD6	6 Pin Plug-Shielded	$1.20
DIN-PD7	7 Pin Plug-Shielded	$1.30
DIN-PD8	8 Pin 270 Degree Plg	$1.40
DIN-PD8A	8 Pin DIN Plg	$1.35
DIN-PDM3	3 Pin Micro DIN Plg	$2.55
DIN-PDM4	4 Pin Micro DIN Plg	$2.55
DIN-PDM5		$2.65
DIN-PDM6	6 Pin Micro DIN Plg	$2.75
DIN-PDM7		$2.90
DIN-PDM8	8 Pin Micro DIN Plg	$3.05
DIN-RA-SKT	RA 5 Pin DIN Skt MAB5SH	$2.80
DIN-SD2	2 Pin DIN Skt	$0.70
DIN-SD3	3 Pin Inline Skt	$1.05
DIN-SD5	5 Pin 180 Degree Skt	$1.35
DIN-SD5A	5 Pin Domino Skt	$1.30
DIN-SD5B	5 Pin DIN Inline Skt	$1.35
DIN-SD6	5 Pin DIN Skt	$1.40
DIN-SD7	7 Pin DIN Skt	$1.40
DIN-SD8	8 Pin 270 Degree Skt	$1.70
DIN-SD8A	8 Pin DIN Inline Skt	$1.65
DIN-SDM4	4 Pin Mini DIN Line Skt	$2.50
DIN-SDM6	6 Pin Mini DIN Line Skt	$1.45
DIN-SDM8	8 Pin Mini DIN Line Skt	$1.45

ZERO INSERTION

IC-TEXTOOL-16	16 Pin ZIF Skt	$21.45
IC-TEXTOOL-20	20 Pin ZIF Skt	$30.95
IC-TEXTOOL-24	24 Pin ZIF Skt	$26.40
IC-TEXTOOL-28	28 Pin ZIF Skt	$29.20
IC-TEXTOOL-40	40 Pin ZIF Skt	$48.70

RCA

RCA1.B	RCA Inline Skt	$0.55
RCA1.R	RCA Inline Skt	$0.55
RCA1.Y	RCA Inline Skt	$0.55
RCA1.W	RCA Inline Skt	$0.55
RCA1M.B	RCA Inline Skt	$1.30
RCA1M.R	RCA Inline Skt	$1.30
RCA2.B	RCA Plug Plastic	$0.55
RCA2.R	RCA Plug Plastic	$0.55
RCA2.Y	RCA Plug Plastic	$0.55
RCA2.W	RCA Plug Plastic	$0.55
RCA2M.B	RCA Plug-Metal	$1.30
RCA2M.R	RCA Plug Metal	$1.30
RCA3B	RCA Chassis Skt	$0.80
RCA3R	RCA Chassis Skt	$0.80
RCA3I	RCA Chassis Skt	$0.90
RCA32	Terminal Board 2 Skts	$1.05

SCSI

SCSI-INLINE-TERM	SCSI Terminator 50M/50F	$19.95
SCSI-TERMINATOR	50 Ohm SCSI Terminator	$13.95
SCSI/SCSI-2	50 Pin SCSI-1 to SCSI-2	$59.95

TELEPHONE

TEL-CNC6	6 x 6 US Plg to US Skts	$4.05
TEL-CNC7	Inline 6 x 4 Joiner	$4.00
TEL-RJ45-JOINER	RJ45 Inline Join	$3.70
TEL-CNC8	6 x 6 US Entry Box	$3.55
TEL-CNC10	6 x 6 US Entry Box	$4.10
TEL-CNC11	Dual 6 x 6 US Entry	$8.15
TEL-CNL9	6 x 6 Extension Cable	$8.20
TEL-CNL11	5M 6 x 6 Dual Extn	$9.10
TEL-CNL16	5M 6 x 6 Plg to Plg	$7.20
TEL-PT1	Telephone Plg	$5.10
TEL-PT2	Telephone Skt	$5.65
TEL-PT3	Telephone Entry Box	$5.65
TEL-PT5	Telephone Plug	$7.15
TEL-PT7	Inline 6 x 4 Joiner	$4.20
TEL-PT8	Modular Wall Socket	$5.10
TEL-PT14	PCB 4 Way 4 Wire	$2.55
TEL-PT16	PCB 6 x 6 Skt	$2.55
TEL-PT18	PCB 8 x 8 Skt	$4.55
TEL-PT25	US Plg to Dual US Skts	$10.05
TEL-PT35	RJ45 Patch Cord 2 Metre	$4.95
TEL-PT35L	RJ45 8 Way 5 Metres	$6.45
TEL-PT28	RJ45 Dual Adaptor	$8.25
TEL-PT44	Plug-4 Slot 4 Pin Wired	$3.10
TEL-PT64	6 x 4 Modular Plug	$3.25
TEL-PT66/5	6 x 6 Modular Plug	$3.95
TEL-PT88	RJ45 8 Way Plug	$7.45
TEL-2	Dual Adaptor	$8.50
TEL-2C	Australian Plg to 2 Skt	$10.20
TEL-2D	Telephone Dual Adaptor	$11.10
TEL-3	Telephone Dual Adaptor	$20.35
TEL-4	5M Extension Cable	$14.25
TEL-5	2.5M Extension Cable	$12.35
TEL-6	10M Extn Cable	$18.40
TEL-8	Aust Plug to US Skt	$7.05
TEL-9	6 x 4 Extension Cable	$7.65
TEL-11	5M 6 x 4 Dual Extn	$7.15
TEL-14.C	4 x 4 Curly Cord	$5.50
TEL-16	5M 6 x 4 Plg to Plg	$4.50
TEL-18	5M 8 x 8 Plug to Plug	$6.95
TEL-21	Telephone Extn Bell	$30.25

SOLDER D TYPE

9 PIN

D-09/09-SHELL	9 to 9 Shell	$2.90
D-09/25-SHELL	9 to 25 Shell	$3.05
D-09-PLG	9 Pin Solder Plg	$0.60
D-09-SHELL-MTLSD	9 Pin Backshell	$1.05
D-09-SKT	9 Pin Solder Skt	$0.50
D-09-SHELL	9 Pin Backshell	$0.55
D-09-PLG-RA-7.2M	9 P. R/A Plg Sh	$1.10
D-09-SKT-RA-7.2M	9 P. R/A Skt Sh	$1.20

15 PIN HIGH DENSITY

D-0915-PLG	9 Pin Shell W/ 15 Pins	$1.55
D-0915-SKT	9 Pin Shell W/ 15 Pins	$1.55
D-0915-SKT-RA-7	H. D. 15 Pin PCB	$2.00

15 PIN

D-15-PLG	15 Pin Solder Plg	$0.90
D-15-PLG-RA-7.2M	15 P.R/A Plg Sh	$2.00
D-15-SKT	15 Pin Solder Skt	$0.90
D-15-SKT-RA-7.2M	15 P.R/ASkt Sh	$1.55
D-15-SHELL	15 Pin Backshell	$0.70
D-15-SHELL-MTLSD	15 P. Met Shell	$1.10

19 PIN

D-19-PLG	19 Pin Solder Plg	$1.60
D-19-SKT	19 Pin Solder Skt	$1.60
D-19-SHELL		$1.00

23 PIN

D-23-PLG	23 Pin Solder Plg	$1.90
D-23-SKT	23 Pin Solder Skt	$1.35
D-23-SHELL	23 Pin Backshell	$1.55

25 PIN

D-25/25-SHELL	25 to 25 Shell	$1.80
D-25-PLG	25 Pin Solder Plg	$1.00
D-25-PLG-RA-7.2M	25 P.R/A Plg Sh	$1.75
D-25-PLG-STR-PCB	25 P. Str P PCB	$3.60
D-25-SKT	25 Pin Solder Skt	$1.00
D-25-SKT-RA-7.2M	25 P.R/A SktSh	$1.88
D-25-SHELL	25 Pin Backshell	$0.65
D-25-SHELL-MTLSD	25 P. Met Shell	$1.10

37 PIN

D-37-PLG	37 Pin Solder Plg	$1.70
D-37-SKT	37 Pin Solder Skt	$1.70
D-37-SHELL	37 Pin Backshell	$1.90

50 PIN

D-50-PLG	50 Pin Solder Plg	$4.85
D-50-SKT-RA-7.2M		$6.95
D-50-SKT	50 Pin Solder Skt	$4.85
D-50-SHELL	50 Pin Backshell	$3.90
D-HEX-NUTS/50		$8.00
D-JACK-SCREWS	Jack Screws/Pair	$0.60

IDC D TYPE

IDC-D09-PLG	9 Pin IDC D Plg	$3.80
IDC-D09-SKT	9 Pin IDC D Skt	$3.80
IDC-D15-PLG	15 Pin IDC D Plg	$3.80
IDC-D15-SKT	15 Pin IDC D Skt	$3.88
IDC-D25-PLG	25 Pin IDC D Plg	$4.30
IDC-D25-SKT	25 Pin IDC D Skt	$3.75
IDC-D37-PLG	37 Pin IDC D Plg	$6.70
IDC-D37-SKT	37 Pin IDC D Skt	$9.25

Machine Sockets, Headers and Transition Sockets next month....

8.30am to 5.00pm Mon to Thurs., 8.30am to 4.30pm Friday.
Mail Orders add $5.00 min to cover postal charges.
Next day delivery in Sydney add $8.00.
All prices include Sales Tax unless stated otherwise.
Tax exemption certificates accepted if the line value exceeds $10.00.
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GEOFF WOOD ELECTRONICS

Geoff Wood Electronics Pty Ltd and Semtech

(inc in N S W)

229 Burns Bay Road, Lane Cove West
N S W 2066 (Corner Beatrice Street)

Telephone : (02) 428 4111 Fax : (02) 428 5198

EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
Altronics	WA	●	●	●	●	●	●	●
Companion Computers	VIC		●					
Dick Smith Electronics	ALL	●	●	●	●	●	●	●
Emona Instruments	NSW						●	
Geoff Wood Electronics	NSW	●	●	●	●	●	●	
Jaycar Electronics	Eastern	●	●	●	●	●	●	●
Kalex	VIC			●				
Macservice	VIC						●	
RCS Radio	NSW			●				
Rod Irving Electronics	Eastern	●	●	●	●	●	●	●
Scientific Devices	VIC						●	
TECS	VIC	●	●	●	●	●	●	●
Wagner Electronics	NSW		●		●	●	●	

KEY TO CODING:

A Kits and modules
B Tools
C PC boards and supplies
D Components
E IC chips and semiconductors
F Test and measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

Electronics Australia Reader Services

SUBSCRIPTIONS: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Co, PO Box 199, Alexandria 2015; phone (02) 353 9992.

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PHOTOSTAT COPIES: When back issues are exhausted, photocopies of articles can be supplied. Price $7.50 per project or $15 where a project spreads over several issues.

PCB PATTERNS: High contrast, actual size transparencies for PCBs and front panels are available. Price is $5 for boards up to 100sq.cm, $10 for larger boards. Please specify negatives or positives.

PROJECT QUERIES: Advice on projects is limited to postal correspondence only and to projects less than five years old. Price $7.50. Please note that we cannot undertake special research or advise on project modifications.

Members of our technical staff are not available to discuss technical problems by telephone.

OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.

PAYMENT: Must be negotiable in Australia and payable to 'Electronics Australia'. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form).

ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria, NSW 2015; phone (02) 353 0620.

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ADVERTISING INDEX

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

COLOUR MONITOR

Used but guaranteed 12" colour computer monitors: **$40**

MOTORS

Small but powerful **GEARED AC** motor. 1 RPM/60Hz/24V/5W. We supply a circuit diagram that shows how to power this motor from 12V DC: Variable speed/full power (Bridge output). Bargain priced: **$9**

MOTOR SPECIAL: These motors can also double up as generators. Type M9: 12V, I no-load = 0.52A - 15,800 RPM at 12V, 36mm dia, 67mm long, **$5**. Type M14: made for slot cars, 4-8V, I no-load = 0.84A at 6V, at max efficiency I = 5.7A - 7500 RPM, 30mm dia, 57mm long, **$5**

POLYGON SCANNERS: Precision motor with 8-sided mirror, plus a matching PCB driver assembly. Will deflect a laser beam and generate a line. Needs a clock pulse and DC supply to operate, information supplied. SPECIAL REDUCED CLEARANCE PRICE **$15**

NEW - IR REMOTE SWITCH

Consists of a PCB and all on-board components for an IR receiver with a toggle output. Includes a new commercial ready-made slimline IR remote control transmitter, designed for a CD player. Press any button on the IR transmitter to toggle the output on the receiver: The system has up to 20m range and will also work from most other IR remote controls! Receiver has an IC "front end" and operates from 8-15V DC, and will drive a relay. Transmitter operates from two AAA batteries (Not supplied). Unbelievable pricing: **$18** Suitable 12V 8A relay with 4kV isolation: **$3**, 12V DC plugpack: **$10**.

VISIBLE LASER DIODE KIT
670nm 5mW complete kit $35
ON SPECIAL

COMPONENTS

SUPERCAPS 0.047F 5.5V **5 for $2**

PCB MOUNTED SWITCHES 90 deg. 3A - 250V, SPDT: **4 for $2**

CASED TRANSFORMER 230: 1.7V 300mA AC - in small plastic case with 2m long input and output leads: **$6**

CASED TRANSFORMERS In attractive plastic instrument box, Mains lead - plug at input, two separate outputs of 8.5V - 3.4A with leads: **$15**

INDUCTIVE PROXIMITY SWITCHES Detect ferrous and non-ferrous metals at close proximity, AC or DC powered types, 3-wire connection for connecting into circuitry: Two for the supply,and one for switching the load, these also make excellent sensors for rotating shafts etc.: **$22 ea. or 6 for $100**

HIGH INTENSITY RED LEDS 550 - 1000mCd @ 20mA, 100mA max, 5mm: **10 for $4 or 100 for $30**

EPROMS: 27C512, 512K (64K x 8), 150ns access CMOS EPROMs. Removed from new equipment, need to be erased, guaranteed, **$4**.

PCB WITH AD7581LN IC: PCB with many components including a MAXIM AD758ILN IC, 8-bit, 8-channel memory buffered data acquisition system designed to interface with microprocessors, **$29**.

ARGON LASER Large water cooled ARGON laser that outputs 7W of blue - green, or 1W of red via an inbuilt Dye laser. Originally for medical use, has only had 200 hours of use! **$12000**

POWER SUPPLY

Used but very clean non standard computer power supplies, enclosed in metal casing with perforated ends for air circulation, built in fan, IEC input connector and OFF-ON switch, "flying" DC output leads, overall dimensions: 87 x 130 x 328mm,110-220V input, +5V @ 8A, +12V @ 3A, and -12V @ 0.25A DC outputs. BARGAIN PRICED: **$18 ea. or 4 for $60**

CABLES

IEC EXTENSION LEADS: 2m, with IEC plug and IEC socket **$5.**

IEC LEADS Heavy duty 3 core (10A) 3m leads with IEC plug one end and an European plug the other: **$1.50 ea. or 10 for $10**

MODULAR TELEPHONE CABLES 4 way modular curled cable with plugs each end, also a 4m 8-way modular flat cable with plugs each end, one of each for: **$2**

MORE ITEMS & KITS
Poll our **(02) 579 3955 or (02) 579 4985** fax numbers for instructions on how to get our item and and kit lists. MANY MANY MORE ITEMS AND KITS THAN THOSE LISTED HERE. *You can also ask for these lists to be sent with your next order.*

LITHIUM BATTERIES: Button shaped with pins, 20mm diameter, 3mm thick. A red LED connected across one of these will produce light output for over 72 hours (3 days): **4 for $2**

3" CONE TWEETERS Sealed back dynamic 8 ohm tweeters: **$5**

DOT MATRIX LCDs

Brand new Hitachi LM215 400 X 128 dot matrix liquid crystal displays in an attractive housing. These have driver ICs fitted but require an external controller. Effective display size is 65 x 235mm. Priced at less than 10% of their real value: **$25 ea. or 3 for $60**

VEHICLE COMPUTER
Originally for bicycles, these suit any moving vehicle with wheels! 9-function computer with speed, average speed, maximum speed, distance, odometer, timer, scan, freeze frame memory, and a clock. Microprocessor circuitry can be adapted to work with almost any wheel diameter. Divide the wheel diameter in millimeters by 6.8232, and program the result into the computer. **$29.90**

$215 CCD VIDEO SECURITY SYSTEM
Mono CCD camera on a small PCB. Includes auto iris lens. Works with illumination to 0.1 lux and is IR responsive. This new camera is nearly 1/2 the size of the unit previously supplied, almost match box size! Can be used in total darkness with IR illumination: **NEW LOW PRICE $180.**
We can also supply with each camera a used, guaranteed 12V DC green computer monitor and a simple kit to convert it to work with the CCD camera. Monitor **$25**, kit **$10.**
A COMPLETE 12V CCD VIDEO SECURITY SYSTEM FOR $215!!

12V-2.5W SOLAR PANEL SPECIAL
These US made amorphous glass solar panels only need terminating and weather proofing. We provide terminating clips and a sheet of glass. The terminated panel is glued to the backing glass, around the edges only. To make the final weatherproof panel look attractive some inexpensive plastic L angle can be glued to the edges with silicone glue. Very easy to make. Dimensions: 305x228mm, Voc: 18-20V, Isc: 250mA. SPECIAL REDUCED PRICE! **$20 ea. or 4 for $60.** Each panel is provided with a sheet of backing glass, terminating clips, isolating diode and instructions. A very efficient switching regulator kit is also available: Suits 12-24V batteries, 0.1-16A panels, **$27**. Also available, a simple and efficient shunt regulator kit, **$5**.

POWER SUPPLIES

EHT POWER SUPPLY; Out of new laser printers, deliver –600V, 7.5kV and +7kV when powered from a 24V-800mA DC supply, enclosed in a plastic case, **$16.**

SWITCH MODE POWER SUPPLIES: Mains in (240V), new assembled units with 12V - 4A and 5V - 4A DC outputs, **$32.**

BATTERY CHARGER S2 accessory set for Telecom Walkabout "Phones". Includes cigarette lighter cable, fast rate charger, and desktop stand. Charges 6 series connected AA Nicad batteries: **$27**

Brand new 40 character by 2-line LCD displays with built in driver circuitry that uses Hitachi ICs, easy to drive 'standard' displays, brief information provided, **$30 ea. or 4 for $100.**

MAINS LASER SPECIAL

Includes a compact potted US made power supply which can be powered from 110/220-240V AC, a 2-3mW He-Ne tube, a ballast resistor and instructions. The power supply requires 4-6V @ 2mA DC. Brand new components. Giveaway price: **$65**

RUBY LASER HEADS

These complete and functional heads include a flash tube, mirrors, and 4" ruby rod! Produce a high-intensity visible red beam! Circuits & components to drive these soon available. Dangerous, so restricted sales. Limited quantity. **$695**

IMAGE INTENSIFIER TUBES

Used but in excellent condition, second generation image intensifier tubes. Can be used to make small and very sensitive scope that can produce high resolution pictures in very low illumination. US made tubes that produce superior results! **$650**

BLEMISHED 3-STAGE TUBES We have a good number of 40mm three stage fibre optically coupled 3-stage image intensifiers that have minor blemishes: Similar to above but three tubes are supplied already bonded together: Extremely high gain!! Each of these tubes will be supplied with the power supply components only. See SC Sept. 94. **$200**

KITS

SINGLE CHANNEL UHF REMOTE CONTROL SC Dec. 92, one Tx and Rx: **$45**, extra Tx **$15.**

4-CHANNEL UHF REMOTE CONTROL KIT: Two Tx & 1 Rx **$96.**

LOW COST 1-2 CHANNEL UHF REMOTE CONTROL A single channel 304MHz UHF remote control with over 1/2 million code combinations with provision for a second channel expansion. The low cost design includes a complete compact keyring transmitter kit, which includes a case and battery, and a PCB and components kit for the receiver that has 2A relay contact output!. Tx kit **$10**, Rx kit **$20** additional components to convert the receiver to 2 channel operation (Extra decoder IC and relay) **$6**. INCREDIBLE PRICES: complete 1 channel Tx-Rx KIT: **$30** complete 2 channel Tx-Rx kit: **$36** additional transmitters: **$10**

MASTHEAD AMPLIFIER KIT: Two PCBs plus all on-board components: Low noise (uses MAR-6 IC), covers VHF-UHF, **$18**

LASER BEAM COMMUNICATOR KIT: Tx, Rx, plus IR laser: **$60**

ELECTRIC FENCE KIT: PCB and components, includes prewound transformer: **$40**

FM TRANSMITTER KIT - MKII high quality - high stability, suit radio microphones and instruments, 9V operation, the kit includes a PCB and all the on-board components, an electret microphone, and a 9V battery clip: **$11**

FM TRANSMITTER KIT - MK1 This complete transmitter kit (miniature microphone included) is the size of an AA battery, and is powered by a single AA battery. We use a two AA battery holder (provided) for the case, and a battery clip (shorted) for the switch. Estimated battery life is over 500 hours!! **$11**

OATLEY ELECTRONICS
PO Box 89, Oatley NSW 2223
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major cards accepted with phone and fax orders
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